MALAYSIAN AGRICULTURAL PRODUCTIVITY GROWTH, 1970-2000

By
Saad Mohd Said
Senior Lecturer, Department of Economics,
Faculty of Economics and Administration,
University of Malaya,
50603, Kuala Lumpur.
(saadms@um.edu.my)

Azmah Hj Othman
Lecturer, Department of Development Studies,
Faculty of Economics and Administration,
University of Malaya,
50603, Kuala Lumpur.
(g3azmah@um.edu.my)

Fatimah Said
Associate Professor, Department of Economics,
Faculty of Economics and Administration,
University of Malaya,
50603, Kuala Lumpur.
(fatimahs@um.edu.my)

The paper utilizes the growth accounting model to estimate total factor productivity (TFP) growth of Malaysian agricultural sector during 1970-2000 and for three sub-periods, 1970-1980, 1981-1990 and 1991-2000. We apply the neoclassical Cobb-Douglas agricultural production function with four inputs, viz. land, labour, fertilizers consumption and machinery. The results show that Malaysian agricultural output growth during the period of study was productivity-driven growth. TFP growth contributed about 2.83 percent to the Malaysian agricultural output growth of 3.52 percent during 1970-2000. This was then followed by the contribution from land, machinery and fertilizer growth and a negative contribution from labour. Although TFP growth has been the prime source of agricultural output growth, its contribution was on declining trend, presumably due to the deterioration in technical efficiency.
1. INTRODUCTION

Growth in agricultural inputs and improvement in total factor productivity (TFP) are two important factors determining the growth of agricultural output over time. Although increases in agricultural inputs may lead to impressive short term output growth, but it is the long term growth in TFP that will contribute to sustainable increases in agricultural output. TFP measures the growth in total output not accounted for by the growth in basic total inputs, such as land and labour.

Growth in TFP is of interest to economists and policymakers, because growth in agricultural productivity is regarded as a necessary condition for welfare improvement and economic development (Hayami and Ruttan, 1971). An increasing agricultural productivity can directly contribute to an increasing rural income, alleviation of poverty and improving the standard of living. Besides providing a constant source of food supply for increasing population, the growth in agricultural productivity would ensure a reliable and sufficient supply of agricultural inputs to the manufacturing sector, especially the agro-based industries and the service sector.

To our knowledge, currently there are only three studies which attempted to estimate TFP growth for Malaysian agriculture (Naziruddin 1997; Arnade, 1998; Jamal and Mansor, 2001). By utilizing the Tornqvist index number procedure, Naziruddin (1997) estimated TFP growth to the Malaysian rice sector during 1980-1990. Using the linear programming approach Arnade (1998), on the other hand, estimated productivity growth for Malaysian agriculture during 1961-1993, without attempting to disentangle the sources of output growth. By adopting the Cooley-Prescott time-varying parameter model, Jamal and Mansor (2001) estimated TFP growth and identified sources of
agricultural output growth for the period 1960-1996. However, they have included only three inputs, viz. land, labour and capital, in their model.

Thus, the objective of our study is to obtain the latest estimate of TFP growth for the agricultural sector during 1970-2000 and identify the sources of agricultural output growth. The paper applies the conventional growth accounting framework to the Cobb-Douglas production function with four-input model. This paper is divided into seven parts. Part 2 discusses the theoretical framework and sources of data. Malaysian agricultural development is presented in Part 3. Part 4 discusses the estimation results of sources of agricultural output growth. Interpretations of results and policy implications are presented in Part 5 and Part 6. Finally Part 7 presents the conclusion.

2. THEORETICAL FRAMEWORK AND SOURCES OF DATA

The concept of TFP growth and its measurement was first developed by Solow (1957) in his conventional growth accounting framework. This framework was further elaborated by other scholars, such as Kendrick (1961), Denison (1967), Christensen, Cummings and Jorgenson (1980), Gollop and Jorgenson (1986) and Maddison (1987). In essence, the framework decomposed the rate of growth of output into the contributions of the rate of growth of labour and capital inputs, plus a residual term, normally referred to as the rate of growth of TFP.

Thus, the TFP growth is that growth in total output not accounted for by the growth in basic total inputs. It is normally attributed to technical progress, advance of knowledge, greater efficiency of the production system, improvements in the quality of inputs, better farm management and cultivation practices, efficient use of traditional
inputs such as land and labour, greater utilization of non-traditional inputs such as high yielding varieties of seeds, fertilizers, pesticides, irrigation and modern agricultural machinery and equipment and changes in cropping pattern towards high value added crops.

Following the World Bank (1993) we utilize the Cobb-Douglas production function approach to estimate TFP growth based on the growth accounting framework. TFP growth is the residual obtained by subtracting the contributions of inputs from the growth of output. Consider a neoclassical Cobb-Douglas agricultural production function with four inputs, given by:

$$ Y = \alpha A^{\beta_1} L^{\beta_2} F^{\beta_3} M^{\beta_4} $$

where $Y$ is agricultural output, $A$ is agricultural area or land, $L$ is labour, $F$ is fertilizers consumption and $M$ is agricultural machinery. $\alpha$ and $\beta_i$ are constants with $\alpha > 0$ and $0 \leq \beta_i \leq 1$, $i = 1, 2, 3, 4$. This production function is sometimes called linear homogeneous. The returns to scale are measured by the sum of $\beta_i$. If the sum of $\beta_i$ equal to one we have constant returns to scale, less than one decreasing returns to scale and more than one increasing returns to scale. Constraining inputs in the Cobb-Douglas agricultural production function to exhibit constant returns to scale,

$$ Y = \alpha A^{\beta_1} L^{\beta_2} F^{\beta_3} M^{\beta_4} f(t) $$

where $\beta_1 + \beta_2 + \beta_3 + \beta_4 = 1$ and $f(t)$ is the term capturing the exhibit of non-constant returns to scale, and is normally referred to as TFP. Taking logarithm on both sides

$$ \ln Y = \ln \alpha + \beta_1 \ln A + \beta_2 \ln L + \beta_3 \ln F + \beta_4 \ln M + \ln f(t) $$

Differentiating equation (3) with respect to $t$, we get:
\[
\frac{1}{Y} \frac{dY}{dt} = \frac{1}{A} \frac{dA}{dt} + \frac{1}{L} \frac{dL}{dt} + \frac{1}{F} \frac{dF}{dt} + \frac{1}{M} \frac{dM}{dt} + \frac{1}{f(t)} \frac{df(t)}{dt}
\]

Constraining the condition of constant returns to scale, \( \beta_i = (1 - \beta_2 - \beta_3 - \beta_4) \), we have

\[
\frac{1}{Y} \frac{dY}{dt} = (1 - \beta_2 - \beta_3 - \beta_4) \frac{1}{A} \frac{dA}{dt} + \beta_2 \frac{1}{L} \frac{dL}{dt} + \beta_3 \frac{1}{F} \frac{dF}{dt} + \beta_4 \frac{1}{M} \frac{dM}{dt} + \frac{1}{f(t)} \frac{df(t)}{dt}
\]

\[
\frac{1}{Y} \frac{dY}{dt} - \frac{1}{A} \frac{dA}{dt} = \beta_2 \left[ \frac{1}{L} \frac{dL}{dt} - \frac{1}{A} \frac{dA}{dt} \right] + \beta_3 \left[ \frac{1}{F} \frac{dF}{dt} - \frac{1}{A} \frac{dA}{dt} \right] + \beta_4 \left[ \frac{1}{M} \frac{dM}{dt} - \frac{1}{A} \frac{dA}{dt} \right] + TFP G
\]

where \( \frac{1}{f(t)} \frac{df(t)}{dt} \) is the rate of growth of TFP. Equation (5) shows the contribution of agricultural land, labour, fertilizer consumption and machinery (each weighted by their respective shares in the total output) and the contribution of TFP growth to the agricultural output growth. For changes between discrete points in time, equation (6) can be written as,

\[
\left[ \frac{Y(t) - Y(t - 1)}{Y(t - 1)} - \frac{A(t) - A(t - 1)}{A(t - 1)} \right] = \beta_2 \left[ \frac{L(t) - L(t - 1)}{L(t - 1)} - \frac{A(t) - A(t - 1)}{A(t - 1)} \right]
\]

\[
+ \beta_3 \left[ \frac{F(t) - F(t - 1)}{F(t - 1)} - \frac{A(t) - A(t - 1)}{A(t - 1)} \right]
\]

\[
+ \beta_4 \left[ \frac{M(t) - M(t - 1)}{M(t - 1)} - \frac{A(t) - A(t - 1)}{A(t - 1)} \right]
\]

\[
+ TFP G
\]

In the present study, we estimate equation (7) using the ordinary least-squares (OLS) technique for the time-series data for the period 1970-2000. The OLS estimation to this equation yields estimates of \( \beta_2, \beta_3, \) and \( \beta_4 \). The multiplication of the estimated coefficients of \( \beta_1, \beta_2, \beta_3, \) and \( \beta_4 \) with their respective growth in land, labour, fertilizer and
machinery in equation (5) measures the contribution of these inputs to the agricultural output growth. The contributions of land, labour, fertilizer and machinery and TFP to the output growth were obtained not only for the whole period of 1970-2000, but also for three sub-periods, 1970-1980, 1981-1990, 1991-2000.

This study utilizes an aggregated annual time-series data on agricultural output, land, labour, fertilizers consumption and machinery obtained from the World Development Indicators 2003 and various issues of the Economic Reports published by the Ministry of Finance, Malaysia. Agricultural output is measured in terms of gross domestic products at 1987 constant prices. Land input is measured in terms of hectares of agricultural land. Labour input is defined in terms of number of persons employed and capital input is proxied by the number of tractors used. Fertilizers input is measured in terms of metrics tons of fertilizers consumption, which is composed of nitrogenous, phosphate and potash fertilizers.

3. MALAYSIAN AGRICULTURAL DEVELOPMENT

Malaysia has started its agricultural development in the beginning of 1960s with the launching of the First Malaysia Plan, 1960-1970. Agricultural development in Malaysia is implemented through land development, regional development, agricultural research and development and agricultural policies. Land development programs are carried out through the opening of new land schemes and in-situ program such as land rehabilitation and consolidation, replanting schemes, modern irrigation schemes and integrated agricultural projects.
Regional development emphasized on balanced development between rural and urban areas through the basic strategy of locating small-scale industries in modern agricultural areas. Agricultural research is carried out by institutions such as Malaysian Agricultural Research and Development Institute (MARDI), Rubber Research Institute of Malaysia (RRIM), Forest Research Institute of Malaysia (FRIM) and local Universities. Besides involving in research activities, these agencies are also involved in disseminating their research findings to farmers through extension and support services.

Since 1984, Malaysia has already launched three National Agricultural Policy, viz. the First National Agricultural Policy, 1984-1991; the Second National Agricultural Policy, 1991-1998; and the Third National Agricultural Policy, 1998-2010. The thrust of various agricultural policies in Malaysia is to transform the agricultural sector into a modern, dynamic and competitive sector. In general, agricultural development in Malaysia focuses on agricultural productivity improvement through a more efficient and greater utilization of agricultural inputs.

Table 1 shows the growth rate of agricultural output and inputs during 1970-2000. There was significant decline in the growth of agricultural output and labour throughout the successive sub-periods. Agricultural output recorded the highest growth rate of 6.13 percent per annum in the first decade of 1970-1980 and successively declined to 0.28 percent during 1991-2000. Labour growth was 1.37 percent per annum during 1970-1980, fell sharply thereafter and recorded negative growth rate.

TABLE 1

Growth Rate of the Malaysian Agricultural Output and Input, 1970-2000
The decline in the growth rate of labour indicates marked shift in reallocation of labour from the agricultural sector to the secondary and tertiary sectors in the economy. A structural shift in employment is evident from Table 2, with agricultural employment declining from 50.5 percent in 1970 to 13.1 percent in 2000. Besides there is also significant decline in the share of agriculture in GDP and increasing importance of the manufacturing sector due to greater emphasis towards industrialization.

**TABLE 2**


<table>
<thead>
<tr>
<th>Period</th>
<th>Output</th>
<th>Land</th>
<th>Labour</th>
<th>Fertilizer</th>
<th>Machinery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-1980</td>
<td>6.13</td>
<td>0.83</td>
<td>1.37</td>
<td>11.34</td>
<td>6.07</td>
</tr>
<tr>
<td>1981-1990</td>
<td>3.90</td>
<td>3.52</td>
<td>-0.05</td>
<td>7.76</td>
<td>14.19</td>
</tr>
<tr>
<td>1991-2000</td>
<td>0.28</td>
<td>1.08</td>
<td>-2.87</td>
<td>-5.08</td>
<td>5.31</td>
</tr>
<tr>
<td>1970-2000</td>
<td>3.52</td>
<td>1.78</td>
<td>-0.46</td>
<td>4.89</td>
<td>8.45</td>
</tr>
</tbody>
</table>

Source: *Economic Report*, Ministry of Finance, Malaysia, various issues

*World Development Indicators*, 2003, World Bank
In terms of the use of non-traditional inputs, Table 1 shows that during the first two decades of 1970-1990, the growth rate of fertilizer and machinery was higher than the growth rate of land and labour. This reflects the increasing use of the modern inputs in substitution for labour and land, the traditional inputs, which have becoming scarce in agricultural sector. However, during 1991-2000, the growth rate of all inputs declined as compared to the previous period and this caused agricultural output to fall further to 0.28 percent.

4. RESULTS: SOURCES OF AGRICULTURAL OUTPUT GROWTH

Table 3 presents our estimates of sources of Malaysian agricultural output growth for the whole period of 1970-2000 and for three sub-periods. It is obvious that Malaysian agricultural output growth during the period of study was productivity-driven growth. For the overall period of 1970-2000, output grew at 3.52 percent per annum and out of this TFP growth accounted for 2.83 percent (or contributing almost 80 percent of output
growth), with the remainder of the growth was attributable to land, machinery and fertilizer growth. However, the contribution from labour growth during this period was negative.

### TABLE 3

A closer look at the sources of growth between successive time periods provides important insights into the growth process of Malaysian agriculture. During 1970-1980, the growth of agricultural output was largely accounted for by the growth in productivity. TFP accounted for 4.65 percent (or contributing almost 76 percent) of the output growth of 6.13 percent. Labour seemed to be the second source of output growth, followed by land, fertilizer and machinery.

The following two sub-periods showed that TFP growth still remained as an important source of output growth, followed by land, machinery and fertilizer. What is most striking is that the contribution of labour to the agricultural output growth declined significantly and became negative in the last two sub-periods. In fact starting from 1981, labour ceased to be a contributing factor to agricultural output growth. This is not surprising because since 1980’s, Malaysian agricultural sector as a whole, experienced negative employment growth and has been facing shortage of farm labour due to rural-urban migration.

Comparison of our findings with past studies is not appropriate due to differences in methodologies, inputs measurements and period of studies. However, in order to arrive at some general picture of TFP performance in Malaysian agricultural sector, an
attempt is made to compare our results with similar studies, either in Malaysia or in other countries.

The domination of productivity-driven growth in Malaysian agriculture seemed to exhibit similar pattern with the growth of agricultural output in other countries. Lin (1992) for instance, found that TFP growth contributed for about half of the China’s agricultural output growth during 1978-1987. He also found sharp decline in the contribution of labour to output growth due to a swift of flow of labour force from the cropping sector. The same growth phenomenon was observed in India. Dholakia and Dholakia (1993) found that TFP growth contributed significantly to the acceleration of Indian agricultural growth in the 1980’s. They also found declining contribution of land, labour and capital to the agricultural growth.

Our estimate of TFP growth is somewhat higher than the earlier findings in Malaysia. Naziruddin (1997) found TFP growth for the new project in the rice sector during 1980-1990 was 2.22 per cent. Study by Arnade (1998) revealed an average annual productivity growth of 1.51 per cent for Malaysian agriculture during 1964-1993. Jamal and Mansor (2001), on the other hand, found that TFP growth rate for the agricultural sector during 1960-1996 was 0.74 per cent. Differences in the results obtained could be due to differences in methodologies, inputs measurements, sources of data and period of study.

5. INTERPRETATION OF RESULTS

Our finding in the previous section reveals that TFP growth was the dominant source of agricultural output growth during 1970-2000. Though TFP growth remained as an
important source of growth in each sub-period, its growth was on declining trends. TFP recorded the highest growth of 4.65 percent during 1970-1980 and successively declined to 1.54 percent during 1991-2000 (Table 3). Since TFP measures the technological progress and the technical efficiency with which inputs are utilized, thus the deterioration in TFP growth reflects to some extent the deterioration in technological progress and/or deterioration in technical efficiency in Malaysian agricultural sector. Basically, there are two sources of technical inefficiency which contribute to productivity decline viz. technology adjustment and input subsidies (Barker, Gabler and Winkelmann, 1981; Arnade, 1998).

Firstly, the adoption of modern inputs often requires farmers to change their technology or production practices. This technology adjustment can create inefficiency and lead to declines in TFP if no improvement in extension services is made to guide farmers for the efficient utilization of new technology. In a study on international agricultural efficiency and productivity, Arnade (1998) found that during 1961-1993 though the modern inputs used has risen in Brazil, India and Indonesia, these countries experienced a decline in efficiency and agricultural productivity.

The inefficiency in the usage of modern inputs in Malaysia is also obvious from Table 1. During 1970-2000, the use of fertilizer and machinery grew (4.89 percent and 8.45 percent respectively) far more than the output growth (3.52 percent). This presumably reflects misutilization of resources since dramatic increases in growth of input does not lead to growth in agricultural output. Poor access to agricultural information and extension services would contribute to decrease in productivity and efficiency of farmers (Aminah and Narimah, 1998). The inefficiency in the use of new
technology also occurs if the farmers have not had enough time to adjust to new technology. A study of efficiency by Huang (1971) in the three paddy growing regions (Kelantan, Selangor and Province Wellsley) found that, given enough time, inefficiency disappears as farmers adjust to new cultivation techniques.

Secondly, input subsidy is another source of technical inefficiency and productivity decline. From the early 1960’s and throughout 1970’s, many developing countries gave subsidies for fertilizers, tractors and credit to encourage agricultural mechanization and modernization (Sanders and Ruttan, 1978). However, subsidies not only create allocative inefficiency, but also lead to technical inefficiency and wasting of inputs. Arnade (1998), for example found that inefficiency in Brazil, India and Pakistan rises over time due to high input subsidies.

Malaysia is of no exception. For example, a subsidy for fertilizer in the paddy sector was first introduced in 1951. In 1979 a new scheme was introduced where free fertilizer was given to farmers who cultivate 2.4 hectares or less. For every hectares of paddy planted up to 2.4 hectares, the farmers get a total of 309 kilogram of free fertilizer (Zaleha and Mohd. Ariff, 1986). In their study on the impact of free fertilizer subsidy on economic efficiency of paddy farmers, Zaleha and Mohd. Ariff (1986) found that the subsidy scheme did encourage farmers to use more fertilizer and the extra amount of chemical fertilizers has been used to inefficient levels.

6. POLICY IMPLICATIONS

Several policy implications can be drawn from the findings of this study. The deterioration in TFP growth may suggest to some extent the inadequacy of support
services in agriculture. The allocation for agricultural support services has been reduced substantially from 10.6 percent of the total development allocation for the agricultural sector (RM241.6 million out of RM2279.4 million) during the Second Malaysia Plan, 1971-1975 to only 4.9 percent (RM409.5 million out of RM8286.9 million) during the Seventh Malaysia Plan, 1996-2000 (Malaysia, 1971 and 1996). Thus, the reduction in the allocation for agricultural support services, which includes agricultural credit, research and development (R&D) and extensions and other services, may have had long term impact in reducing agricultural TFP and output growth.

Successful R&D activities in introducing and disseminating new technology to increase agricultural productivity require strong support and commitment from extension agents. The extension staff should comprise of those of better trained and highly qualified workers. The lack of qualified extension staff is obvious in Malaysia. For instance in 2004, out of 3800 agricultural officers in the Department of Agriculture, only 420 are graduates and 650 are diploma holders. The others are technicians with certificates from agricultural institutes (New Straits Times, 27 June 2004). Effective transfer of agricultural technology normally requires the best qualified extension agents in the fields teaching and helping farmers to modernize agriculture.

Besides having many qualified extension staff, the government should also consider employing more female extension workers. For instance in 1994, the Department of Agriculture had only 213 female agricultural technicians as compared to 1147 male technicians (Aminah and Narimah, 1998). In a study on gender role in Malaysian agriculture, Aminah and Narimah (1998) found that despite active involvement of women in agriculture, however they are generally have poor access to
agricultural information and extension services. The reasons given for the poor access were there were only few women extension agents and male extension agents were insensitive to gender related issues in agricultural production. Increase in the number of women extension staff would increase contact with women farmers, enhanced technological and information flow, generate an equal share of the benefits of technology and mechanization and hence increase the overall productivity.

Subsidies have been identified as a source of productivity decline and could produce technical inefficiencies. However, in Malaysia most of the farmers have survived because of the existence of various types of subsidies, such as input and price subsidies (Muhammad Ikmal, 1988). Though the removal of subsidies may improve efficiency and avoid wastage, its removal may jeopardize rural poor farmers, especially from the rice sector which operates on heavy subsidies. Existing empirical evidence shows that the removal of subsidies increases the incidence of poverty among rural farmers (Muhammad Ikmal, 1988; Firdausy, 1997).

Here we are facing with the problem of trade-off between efficiency and poverty which presumably could be resolved through integrating small-scale farmers into commercial-scale farming companies, improving agronomic practices, utilizing better resources and technology, adopting sound modern agricultural practices and developing more efficient farm management methods. Starting from the Seventh Malaysia Plan 1996-2000, the government has taken steps to review and gradually withdraw the element of subsidy in agricultural inputs. However, their effect on the efficiency of production could persist beyond the subsidy period.
7. CONCLUSION

The study utilizes the standard growth accounting model to estimate TFP growth for Malaysian agricultural sector during 1970-2000 and the three sub-periods 1970-1980, 1981-1990 and 1991-2000. We found that for the overall period of study, TFP growth is the principle factor responsible for Malaysian agricultural output growth, accounting for more than 80 percent of the sector’s growth. The remainder of the growth being attributable to land, machinery and fertilizer. However, the contribution from labour growth during this period was negative.

Even though TFP growth remained as an important source of growth throughout the period, its contribution was declining. TFP recorded the highest growth of 4.65 percent during 1970-1980 and successively decline to 1.54 percent during the last decade of 1991-2000. The decline in TFP growth to some extent reflects the deterioration in technical efficiency in Malaysian agricultural sector which presumably due to inefficient utilization of new technology and modern inputs, such as fertilizer and tractors. Hence, in the face of globalization and world trade liberalization, efforts have to be taken to increase Malaysian agricultural efficiency and productivity by improving, among others, the flow of agricultural information and support services.
References


Muhammad Ikmal, S. “Inequality, Public Expenditure and Malaysia’s National Rice Policy.” *Kajian Malaysia* 6, no.2 (1988):


TABLE 3

Sources of Agricultural Output Growth, 1970-2000

(percent per annum)

<table>
<thead>
<tr>
<th>Period</th>
<th>Output Growth Rate</th>
<th>Land</th>
<th>Labour</th>
<th>Fertilizer</th>
<th>Machinery</th>
<th>TFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-1980</td>
<td>6.13</td>
<td>0.25</td>
<td>0.88</td>
<td>0.05</td>
<td>0.03</td>
<td>4.65</td>
</tr>
<tr>
<td>1981-1990</td>
<td>3.90</td>
<td>1.07</td>
<td>-0.03</td>
<td>0.04</td>
<td>0.71</td>
<td>2.11</td>
</tr>
<tr>
<td>1991-2000</td>
<td>0.28</td>
<td>0.33</td>
<td>-1.84</td>
<td>-0.02</td>
<td>0.27</td>
<td>1.54</td>
</tr>
<tr>
<td>1970-2000</td>
<td>3.52</td>
<td>0.54</td>
<td>-0.29</td>
<td>0.02</td>
<td>0.42</td>
<td>2.83</td>
</tr>
</tbody>
</table>