

Structural Change of The Agricultural Sector : Analysis Based on Input-Output Tables

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Abstract

Considering the strategic importance of the agriculture sector to the Malaysian economy, the 3rd National Agricultural Policy (NAP3) is intended to ensure an enhanced role of the sector in national development. Based on the Malaysian Input-Output Tables 2000, the paper presents the linkages and interdependencies associated with the agriculture sector and highlights the impact of oil palm on the country's economic structure.

Introduction

The importance of the agriculture sector to the Malaysian economy need not be over-emphasised. During the 1998 financial crisis, the recovery in agriculture output, underpinned by a significant improvement in palm oil yield, had contributed towards the positive growth in the economy (Bank Negara Malaysia, 2000).

The New Economic Policy (NEP) in Malaysia was intended to expedite the process of restructuring the society, to correct the economic imbalance and to reduce and resolve completely the race identification by economic functions. An important concern of the policy was to eradicate poverty by uplifting income level as well as increasing job opportunities for Malaysians. Since poverty was more prevalent in the rural areas where the main source of income was from agricultural activities, the development of the agricultural sector was given priority in the implementation of the NEP.

Previously, the Government required the latest data and relevant information as inputs to the 9th Malaysia Plan for planning and formulating appropriate strategies and policies pertaining to the agriculture sector. Subsequently, updated and adequate data would be required for monitoring the progress and performance towards achieving the planned targets. This is also in line with the midterm review of the 9th Malaysia Plan.

The 3rd National Agricultural Policy (NAP3) for the period 1998 – 2010 sets strategic directions for agricultural and forestry development to the year 2010. This policy has been formulated to ensure that the agricultural sector's strategic role in national development is sustained and enhanced in the light of new and emerging challenges facing agricultural development.

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Towards this end, the NAP3 will focus on new approaches to increase productivity and competitiveness, deepen linkages with other sectors, venture into new frontier areas as well as conserve and utilise natural resources on a sustainable basis. The policy aims to set in place the enabling and supportive measures as well as a conducive environment to promote growth in the agricultural sector. The policies and strategies formulated will continue to emphasise productivity and market driven growth (Ministry of Agriculture and Agro-Based Industry, 2006).

The agricultural sector will remain strategically important as a provider of food and raw materials for the agro and resource-based industrial development during the NAP3. The emphasis on agricultural development will shift from a commodity-based approach to a product-based approach which focuses on production of agricultural products based on market demand and potential, and also, consumer preferences. Complementing the product-based approach, an agro-forestry approach will be adopted to optimise resource use and maximise returns. The rich biological resources of the country will be conserved, managed and sustainably-utilised for the development of new products and future industries as new sources of growth for the agricultural sector (Ministry of Agriculture and Agro-Based Industry, 2006).

An approach employed by policy makers to project, plan and make decisions on national development programs is to use an input-output model. Input-Output (IO) analysis has become an increasingly popular means for analysing regional economic structures and assisting local economic development decision making. IO models provide a variety of useful information. It is a descriptive tool which describes the existing structure of a regional economy; it provides information on individual economic sectors, the linkages between them and how they co-vary. It also shows the relative importance of individual sectors in the overall economy as well as in predicting local responses to changing economic conditions. Input-Output analyses describe the economic transactions pertaining to the economic activity that occurred within specified reference periods (Leatherman, 1994).

Input-Output Tables are compiled to provide comprehensive information on all production activities of an economy. These tables are also used to record the transactions of goods and services between producers and users. The production and transaction among sectors are reflected by a set of supply and use tables as well as a set of symmetric tables that constitute the entire Input-Output Tables.

Sources of data for agriculture sector in Malaysia

The Department of Statistics, Malaysia (DOSM) undertakes immense efforts in collecting and compiling data as well as managing the source of data for the agriculture sector in the country. There are also close collaborations and active involvements with other related agencies in Malaysia in the collection of data. For instance, information on the production of rubber is obtained from the annual inquiries conducted by DOSM. Selected information from the Census of Manufacturing Industries is used for the estimation of the value of logs produced by the forestry activity. Meanwhile, data obtained from the Ministry of Agriculture and Agro-Based Industry and Federal Agriculture Marketing Authority (FAMA) were largely based on information on volume of production, prices and inputs. Other

agriculture (smallholdings n.e.c.) comprises of the entire agricultural smallholding sector with the exception of rubber, oil palm, cocoa, coconut and tea. Included is the cultivation of paddy, vegetables, fruits, coffee, pepper, tobacco, flowers, all other miscellaneous crops and agriculture services. The total output of this industry includes both production for own consumption as well as for the market (DOSM, 2005a).

For paddy, data on production from the Ministry of Agriculture and Agro-Based Industry were used. Information on prices received by farmers for their produce was derived from Beras Nasional Berhad (BERNAS); approved agents/dealers buying prices, rice mills purchase prices as well as from retail prices. Farmers' consumption of own produce was valued at producers' prices i.e. the prices farmers would have received if their produce had been sold instead of for own consumption. Input coefficients of the major paddy growing areas in the country were derived from information on intermediate consumption that was extracted from the various annual survey reports of the Ministry of Agriculture and Agro-Based Industry.

DOSM conducted special annual inquiries (estates only) to pattern intermediate consumption. Data on production of rubber were obtained from the monthly as well as annual reports submitted by the estates. For smallholders, data on production of rubber were calculated as a residual using data on "demands" emanating from exports and local purchases of mills offset by estate production and imports. Production data on oil palm were estimated by using information obtained from the Malaysian Palm Oil Board (MPOB). Output estimation also includes estimation of fixed capital formation arising from new planting.

Another important agency, the Malaysia Cocoa Board (MCB), provides DOSM with information on production of cocoa. The census of cocoa estates conducted by MCB provides the value of intermediate consumption per tonne of dry cocoa beans produced in estates (MCB, 2004).

For statistics on livestock, the production value of milk and eggs were obtained from the Department of Veterinary Services. Data on the number of animals slaughtered and prices received by farmers as well as retail prices for meat were also obtained. The total activity within forestry sub-sectors includes logging, production of firewood and various other minor forest produce. Quantity data for these items were obtained from the Department of Forestry.

As mentioned earlier, in estimating the value of logs produced, prices reported by sawmills covered in the Census of Manufacturing Industries 2000 were used after adjustments were made for transportation costs. Intermediate consumption was based on adjusted data derived from the Logging Survey (Peninsular Malaysia, Sabah and Sarawak). Data from these sources were verified against relevant information pertaining to own concession operations reported by sawmills to the Census of Manufacturing Industries 2000. As for information on marine fish landings, prices received by fisherman (landed prices) and retail prices were obtained from the Department of Fisheries (Department of Fisheries, 2000). Activities such as fish rearing in rice fields and brackish water, aquaculture and other fresh water fishponds were also included in the estimates for the fishing industry (DOSM, 2005b). This shows that there are various agencies involved in providing data on the agriculture

sector in Malaysia. This cooperation is to ensure coordinated and solid data collection as well as reliable and comprehensive estimation of agriculture sector that has become increasingly important to the country.

Malaysian Input-Output Tables

Background

The Input-Output Tables explain and analyse the relationship between producers and consumers as well as its dependence with other industries. It tracks the commodity flow (goods and services) from one industry to another industry. The flow of commodities supplied and used is compiled systematically in the form of input-output tables.

A symmetric IO table is a product or an industry matrix describing the domestic production processes and the transactions in products of the national economy in detail. For example, a two-sector IO table allows us to understand the industrial relationship between agriculture and the rest of the economy, thus highlighting the implications for structural and policy analysis (Pizzoli, 2004).

The first set of IO Tables of Malaysia was published for the year 1978. Subsequently, IO Tables for years 1983, 1987 and 1991 were produced. The latest IO Tables for Malaysia is for the year 2000. The concepts and methodology used in the Input-Output Tables for the year 2000 are based on the 1968 System of National Accounts (SNA) and 1993 System of National Accounts (SNA) published by the United Nations.

Level of aggregation and size of tables

The potential maximum size of the Malaysian IO (MIO) tables is determined by the existing national accounts classification framework. For IO 2000, the classification consists of a total of 1574 commodities, 221 industries and 283 different categories of final demand. For the purpose of IO 2000, all the commodities and industries are classified to arrive at 94 by 94 level and seven categories of final demand. The term final demand used in this paper covers Private Consumption; Government Consumption – Federal, State, Local; Changes in Inventory; Gross Fixed Capital Formation; and Exports (DOSM, 2005b). Out of the 94 categories in MIO, eight sub-sectors represented the agricultural sector and this is an increase from six sub-sectors presented in year 1987. Activities on coconut and tea are two of the additional sub-sectors in agriculture sector and this suits the needs of users and policy makers in the context of Malaysian economy.

Analysis in agriculture sector using the input-output model

Agriculture and GDP

Agriculture was the main economic activity that contributed 39.3 per cent to the Gross Domestic Product (GDP) of the country when Malaysia achieved its independence in 1957. However, the contribution declined after independence as the focus shifted to the manufacturing and services sectors. It declined from 20.0 per cent in 1987 to 14.9 per cent in 1991 and subsequently to 8.7 per cent in 2000. In 2004, the agriculture sector contributed about 8.5 per cent to GDP (DOSM, 2005c).

Out of the percentage share of the agriculture sector to GDP, the highest contribution in 1987 and 1991 was by the forestry and logging sub-sector. However, in year 2000, oil palm contributed 2.8 per cent of GDP, which constituted the highest share among the sub-sectors under agriculture. In 2004, oil palm contributed 3.0 per cent of GDP. From the IO 1991, it was noted that forestry and logging contributed the largest share of exports of about RM3.9 billion. From the IO 2000, forestry and logging exports amounted to RM2.6 billion. Though its exports value decreased compared with that of 1991, it was still the largest contributor to exports in the agriculture sector.

In terms of value added at constant prices (base year 1987), the contribution of the agriculture sector in Malaysia increased from RM16.2 billion in 1987 to RM17.3 billion in year 1991. It continued to increase to RM18.7 billion and RM21.1 billion in 2000 and 2004 respectively. The agriculture sector also contributed to higher export earnings from RM23.0 billion in 2000 to RM29.0 billion in 2003, indicating better prospects in the global market (DOSM, 2005d).

Agriculture sector in the Malaysian Input-Output Tables 2000

The Malaysian Input-Output Tables 2000 showed that the highest value of Operating Surplus was from the forestry and logging sub-sector, which constituted 82 per cent of the total value added in this sub-sector.

a. Output structure

Table 1 : Output by selected sectors - 1987, 1991 and 2000

Sector	2000		1991		1987	
	RM mil	%	RM mil	%	RM mil	%
Agriculture, fishery & forestry	45,427	5.1	26,183	8.6	19,304	13.0
Manufacturing	490,477	54.7	134,908	44.3	57,858	39.0
Services	251,174	28.0	97,867	32.1	49,948	33.3

Table 1 showed the distribution structure of output in the agriculture, manufacturing and services sectors for years 1987, 1991 and 2000. Although there was an increase in output values by the agriculture, fishery and forestry sub-sector, the share of agriculture to overall output declined.

From the table, it can be seen that there were significant increases in output, both value and percentage, by the manufacturing sector throughout the three years. The increases were impressive from RM57,858 million in year 1987 to RM134,908 million in year 1991 and a further increase to RM490,477 million in year 2000. In terms of percentage distribution, it increased from 39.0 per cent in 1987 to 44.3 per cent in 1991 and 54.7 per cent in 2000. This suggests that from the period 1987 to 2000, there was a significant change in the structure of the economy.

The table also showed that the percentage share of the output value of the agricultural sector was high in year 1987, constituting 13.0 per cent of the total output value. However, the share of this sector declined in 1991 and 2000 to 8.6 per cent and 5.1 per cent respectively.

On the contrary, the share of manufacturing sector increased from 39.0 per cent in 1987 to 44.3 per cent in 1991 and 54.7 per cent in year 2000. Similarly, the output was also increasing during the same period. The services sector portrayed the same scenario as the agriculture sector where output value was increasing but the share to overall total output decreased throughout the years.

As mentioned, the number of sub-sectors in the agriculture sector increased from year 1987 to 1991, with the emergence of the coconut and tea sub-sectors in 1991 and 2000. Thus, in respect of the additional number of sub-sectors, agriculture sector has become more important.

b. Input structure

The production cost or input structure of an industry consists of :

- i. intermediate inputs or costs of materials and supplies as well as the non-factor services consumed in production; and
- ii. primary inputs or payments to factors of production including profits - both components give the ratios of input used to produce output by each sector.

Table 2: Intermediate and primary input ratios by selected sectors - 1987, 1991 and 2000

Sector	2000		1991		1987	
	Intermediate	Primary	Intermediate	Primary	Intermediate	Primary
Agriculture, fishery & forestry	0.2652	0.7348	0.2007	0.7993	0.1752	0.4826
Manufacturing	0.3464	0.6536	0.4157	0.5843	0.8248	0.5174
Services	0.2435	0.7565	0.2697	0.7303	0.2523	0.7477

Table 2 showed that the production cost in terms of usage of intermediate inputs changed slightly throughout the three years. In 1987, the amount that industries spent on intermediate inputs on the agriculture sector was an average 18 sen for every Ringgit Malaysia worth of output, increasing to an average of 20 sen in 1991 and 26 sen in 2000, *ceteris paribus* (other factors remain constant). This trend may suggest that there was an increase in the use of intermediate inputs in the agriculture sector within the three years period.

On the contrary, in the manufacturing sector, there was a decreasing pattern in the intermediate input ratio from an average of 82 sen for every Ringgit Malaysia worth of output in year 1987 to an average of 42 sen in year 1991 and a further decrease to an average of 35 sen in 2000. However, there was an increase in primary input ratio (gross value added ratio), albeit this decrease. Meanwhile in the services sector, there was relatively marginal differences in terms of usage of intermediate inputs throughout the years.

The Input-Output Tables 1991 showed that the highest value of Compensation of Employees (CE) in the agriculture sector was in the forestry and logging sector (RM1.7 billion), followed by oil palm estates (RM1.3 billion). In terms of Gross Fixed Capital Formation (GFCF), the highest value was in rubber primary products, followed by oil palm primary products.

In the Input-Output Tables 2000, forestry and logging generated the highest contribution in terms of Value Added (VA), as its Compensation of Employees (CE) was RM1.9 billion, followed by oil palm estates with RM1.3 billion. The trend follows accordingly between the two years and this suggests that in terms of generation of income, the structure for the agriculture sector in Malaysia does not vary too much between the ten years period. The details of Value Added, Compensation of Employees and Gross Fixed Capital Formation for years 1991 and 2000 are shown in Table 3.

Table 3: Value Added, Compensation of Employees and Gross Fixed Capital Formation – Agriculture Sector

Agriculture Sector	2000 (RM million)			1991 (RM million)		
	VA	CE	GFCF	VA	CE	GFCF
Agriculture other	4,877.82	425.77	36.72	3,500.33	984.42	49.25
Rubber planting	1,882.31	311.75	83.50	2,682.19	746.71	296.18
Oil palm estates	7,907.18	1,304.70	579.39	4,510.68	1,255.76	213.07
Coconut	137.79	25.54	1.09	152.35	42.41	0.77
Tea estates	20.24	12.97	1.98	41.36	11.52	0.60
Livestock breeding etc.	1,640.44	327.41	469.18	1,115.41	310.53	151.70
Forestry & logging	10,311.13	1,905.01	-	6,063.56	1,688.08	0.26
Fishing	3,096.42	578.02	-	1,609.06	447.96	0.04

Activities closely related to agriculture are meat and meat production, dairy production, preservation of fruits and vegetables, preservation of seafood, oils and fats, grain mill, bakery, confectionery, other foods, animal feeds, sawmill as well as other forestry. Much of these sectors' inputs come from local farms.

Adding value to products will then continue to increase income. The process will stimulate and affect the whole economy since there are relationships and interdependencies among sectors. For example, processing of fresh fruit bunches and kernel into oil palm will require more labour that will generate more income and further enhance the value of the product. Additional processing with regards to the packaging of products will contribute even more to the generation of local income. Industries that support the processing activities by supplying materials, transportation and business services will also benefit from these processes.

From IO 2000, oils and fats contributed RM34.5 billion of local production and RM11.9 billion to exports. As for generation of income to the economy, this sector contributed RM447 million.

As such, the oils and fats sector had a strong “multiplier” effect on the economy. For each ringgit change in demand of its product, a RM2.63 change in output will be seen throughout the economy. As this sector expands, agriculture and other interrelated industries will also continue to expand and accelerate. This “multiplier” effect is clearly shown in Table 4.

Table 4 : Inverse matrix table of Input-Output Tables 2000

Inverse matrix	Oils and fats	Grain mill products	Bakery products
Oils and fats	1.989	1.019	1.021
Total Impact	2.628	1.923	1.703

Backward and forward linkages

From Table 4, it is apparent that there exists interrelationships between the various sectors in the economy. The output of one sector is another sector's input. Thus, the increase in demand of output in one sector will affect the other business sectors and eventually has a greater impact on the whole economy. Firms that supply inputs to the sector will experience an increase in demand and are expected to also increase their purchase of inputs for their production. These supporting firms purchase of materials and require labour in order to meet the inter-industry demand from the sector that are initially stimulated by final demand changes. The effects on supporting sectors reflect the backward linkages in the economy as firms will be buying from and selling to one another. The backward linkages explains induced production of agriculture to down-stream industries and it can be derived column-down in the Inverse Matrix Table, whereas forward linkage shows the spread of products of the initially stimulated agriculture sector to up-stream industries. Forward linkage can be derived row-right in the same table. Backward linkage from other sectors to the agriculture sector is represented by :

$$BL_j^{AW} = \frac{\sum_i B_{ij}^{AW}}{(\sum_i \sum_j B_{ij}^{AW}) / N}$$

Forward linkage from agriculture sector to other sector is represented by :

$$FL_j^{WA} = \frac{\sum_i B_{ij}^{WA}}{(\sum_i \sum_j B_{ij}^{WA}) / N}$$

Where A indicates agriculture sector
W indicates other sector
N indicates number of sector
B_{ij} indicates inverse matrix

Impact analysis using the IO Tables

The impact analysis from which we derive the “multiplier” effect (see Matrix 1 for technical details) studies a change in one or more elements of final demand (Liu X. et al., 2005). The increase in demand could come from increased export demand which might be initiated by agricultural trade reform or even preferential arrangements. For example, exports of oils and fats in Malaysia is among the largest, amounting to RM11.9 billion. This will also increase the domestic production of oils and fats because it is not only consumed domestically, but are largely meant for the export market. Moreover, many businesses would like to take the opportunity of reaping lucrative gains from the sector.

The impact on other sectors depends on how the sectors are linked to each other. The links are represented by the value of sales or purchases of an industry from other sources including itself. The more a sector is linked to other sectors, the larger would be the overall impact.

Matrix 1 : Technical details of an input-output model

The impact analysis is undertaken by using the IO multipliers that can be derived from input coefficients.

$$AX + F = X$$

where **A** denotes a matrix of coefficients showing the shares of input to total output.

In the Malaysian IO Tables, the input coefficients can be read from the Input Coefficients Table, Domestic Production.

Table 5: Input coefficients, domestic production for selected sectors

Input coefficients, domestic production	Commodity	Agricultural products
Commodity		
Agricultural products	1	0.0763650
Other manufacturing products	2	0.0866621
Services	3	0.0281540
Total Input		1.0000000

(Source : Malaysian Input-Output Tables, 2000, Department of Statistics, Malaysia)

Table 5 shows the proportion of inputs required to produce one ringgit of output. It is calculated by dividing each of the column values in transaction tables by the column sum.

The transaction table refers to Absorption Matrix Table in the Malaysian Input-Output Tables 2000.

Table 6: Absorption matrix (use matrix) for selected sectors

Total Input and Use	Commodity	Agricultural products other
Commodity		RM
Agricultural products other	1	528,490
Other manufacturing products	2	599,752
Services	3	194,842
Total Input		6,920,583

(Source : Malaysian Input-Output Tables 2000, Department of Statistics, Malaysia)

Reading down Table 6 shows that the proportion of input required from each sector listed along the side to produce one ringgit of output by the sector listed at the top.

The interpretation of this table enables us to see what happens if demand for a sector's output increased. For example, in Table 5, an increase of RM1 in the agriculture sector will require approximately RM0.08 worth of input purchases from other agricultural firms, RM0.09 worth of input purchases from the manufacturing sector and from the services sector, RM0.03 worth of input purchases. This reflects the direct effects due to a change in demand.

Further implications of the changes reflected from the table is explained by the following equation:

Matrix 2

$$\mathbf{X} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{F}$$

Where: $\mathbf{A}$ = matrix coefficients showing the shares of input X_{ij} to total output X_j

$\mathbf{X}$ = the column vector of gross output sector

$\mathbf{F}$ = the column vector of total final demands

$\mathbf{I}$ = an identity matrix

The above equation is also known as the Leontief inverse matrix. This shows how much a sector needs to purchase its input from its suppliers in order to increase output to meet the increase in demand.

Thus, any changes in final demand $\mathbf{F}$ will affect output $\mathbf{X}$. Subsequently, the Inverse Matrix Table in the Input-Output Tables will provide the total impact of change in final demand in the economy. The total multiplier indicates the magnitude of the increase in aggregate output that is necessary to meet the increase in demand for output initiated by the increase in final demand.

Future development

Malaysia is planning to extend its IO Tables from 94 level of commodities and industries to 165 level. This will involve more detailed breakdown of the commodities and industries, which will in turn enable more thorough and comprehensive analyses. On the agricultural sector, the detail breakdown will cover commodities such as paddy, fruits, market gardening, aquaculture as well as flower plants for planting or ornamental purposes.

Conclusion

Based on the findings from the Malaysian IO Tables, it is reasonable to conclude that the agriculture sector has an important role in the economic development of Malaysia. Although the country is focusing more on manufacturing and services sectors nowadays, the agricultural sector is still not forgotten. As a matter of fact, agricultural activities have contributed a lot to the development of the economy both directly and indirectly.

Agriculture stimulates the economy and acts as a catalyst that speeds up economic development in Malaysia. New emerging industries such as the agro-based industry is very much dependent on agricultural activities, at least as a source of input. In line with this, the Government of Malaysia is presently encouraging growth of the agricultural sector.

On a broader perspective, the interdependencies observed between the various sectors have important policy implications. Future development of the agriculture sector should seriously pursue efforts in developing new markets for agricultural commodities, adding value through processing of locally produced agriculture products, promoting small business development in the economy, as well as finding substitutes for imported products and services.

Enhancement of value added in the agriculture sector is being actively pursued through research and development activities. For example, palm oil is currently being developed into non-food material such as product of oleo-chemistry. This will further enhance the agricultural sector and generate new demands both domestically as well as internationally. Malaysia, as a major producer and exporter of oil palm, besides Indonesia, is set to benefit from investments in research and development to come up with new products from palm oil. This emerging activity should be given an emphasis in the construction of IO Tables. Thus, the analysis of the structural changes in the agricultural sector over the years can be further materialised.

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