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EVOLUTION OF FERTILIZER USE BY CROPS IN MALAYSIA: RECENT TRENDS AND PROSPECTS

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INTRODUCTION

Agriculture has always played a significant role in the development of Malaysia and continues to make a major contribution to the national economy. In value terms, its gross domestic product (GDP) grew steadily from RM 14.82 billion in 1990 to RM 40.07 billion in 2008. However, the contribution of the agricultural sector reduced from 18.7% to 3.8% during the same period (**Table 1**). This is attributed to the diversification and increase in other economic activities in the country.

The total land use under the agriculture trended upward over the 15 years with bigger increase during the 2000-2005 period. With the fast expansion of oil palm cultivation, the land use under rubber, coconut and cocoa was reduced from 1995-2005 (**Table 2**). The total land use under the Ninth Malaysia Plan (9MP 2005-2010), is expected to increase to 6.9 million hectares. It must be mentioned that the area under oil palm have grown 6-folds over the last 30 years and presently accounted for 39.3% of the major crop area in 1990 and expected to increase to 66.1% by 2010. The total area under oil palm will be about 4.56 million Hectares by the end of 9MP. With the global recession, there is increase pressure to maximize food production to reduce import of agricultural products and the area under fruits and vegetables is targeted to reach 375,000 and 86,000 hectares, respectively by 2010.

The Malaysian government has committed to promote and maintain agriculture as the third engine of growth in the country's economy and this sector has maintained its GDP contribution at about 8.1% of an enlarged national GDP of RM738.67 billion in 2008.

The projected increases in agricultural production to the year 2010 for some crops are shown in **Table 3** (Economic Planning Unit 2007). Agricultural growth will be achieved through expansion and/or further intensification of land use. Between 1995-2010, agricultural land use increased from about 5.5 to about 6.9 million hectares. The growth will be supported mainly by the sustained growth in oil palm and higher production of food crops. The increase in area under mature oil palm and yield improvement can only be achieve through extensive application of Good Agricultural Practices (GAP) and increase in oil extraction rate (OER) in 2009 and beyond.

The importance of fertilizers for achieving increase crop production must be emphasized. The cultivation of high yielding crop varieties requires high and proper supply of macro- and micro-nutrients for sustained and better crop performance and yields. Since fertilizers is usually the highest variable costs item in the crop production budget, it is pertinent that the Government must continue to provide incentives or actions to improve efficiency in the fertilizer industry and to minimize fertilizer prices.

CROP PRODUCTION SYSTEMS

Although rice is cultivated as the major food crop enterprise in Malaysia (about 0.67 million hectares in 2007), oil palm, rubber, cocoa and durian also occupy large areas in the agricultural cropping system. In 2008, there were 4.48, 1.28, 0.21, and 0.11 million hectares of oil palm, rubber, cocoa and durian, respectively.

These crops together with rice occupy almost 98% of the total cultivated agricultural land in Malaysia (Department of Agriculture, 2008). There are basically 3 farm categories which comprise of:

(1) Smallholders (land area < 40 hectares)
(2) New land development schemes
(3) Large commercial holding (estate or plantation)

Over the years, the government through the Ministry of Rural Development and Ministry of Agriculture have encouraged grouping of small farms into mini-estates and "group farming" to achieve economies of scale, better farm resource management and production sustainability. This is the government's policies to improve the living standards of the rural poor and small farmers. The production of the large holdings such as commercial plantations is well organized for both local and overseas markets. Most of these plantations practiced mono-cropping.

Application of adequate quantities of fertilizers is important to sustain high crop yields under these cropping systems. The official fertilizer rates recommended by the relevant government agencies for different crops are shown in **Table 4**. The fertilizer manufacturers and suppliers also provide their product recommendations for use on different crops grown under these cropping systems. According to the Department of Statistics figures and industry estimates, in year 2008 alone, about 4.16 million tones of mineral fertilizers were imported into Malaysia costing RM 9.17 billion (Highest in the history of fertilizers imported for use) (**Table 5**). There is growing trend to complement or substitute mineral fertilizers with some forms of organic fertilizers which are produced locally. This is also the result of increasing fertilizer prices and environmental awareness or concerns.

CLIMATE, SOILS AND AGRO-ECOLOGICAL ZONES

Malaysia has a total land area of 329,733 km^2 which is divided into two geographical regions viz. Peninsular with land area of 131,573 km^2 and East Malaysia which comprises Sabah and Sarawak with land area of 73,711 km^2 and 124,449 km^2, respectively. The regions are separated 650 km apart by the South China Sea and have the same warm humid tropical climate. The humidity is about 85% with temperature ranges from 21 – 32^o C, annual rainfall 2,450 mm and above and year round day length of 12.5 hours (Nieuwolt et.al, 1982). The rainfall in Peninsular Malaysia generally exceeds 1,600 mm and is above 2,500 mm in most areas. The mean annual rainfall in Sarawak is between 2,500 and 5,000 mm and is fairly well distributed with no dry months below 100 mm. Similar rainfall conditions exist in most part of Sabah which is generally moist and wet throughout the year especially towards the inland areas with the

exception of 3 rain-shadow areas. These dry areas are between Tenom and Keningau , Kagopon in the west coast , Semporna in the south east and Tg. Malandong north of Darvel Bay.

The rainfall for both regions is affected by the North-East (November- March) and the South-West (June- August) monsoons which bring heavy rainfall. For the months of April-May and September-October, less rain is experienced because of the changes in the monsoonal winds. In Peninsular, the north eastern states of Kelantan and Trengganu are affected by the North-East Monsoon. However, the west coast states of Peninsular are somewhat shielded from the South West monsoon by the land mass of Sumatra in Indonesia and therefore experiences milder rainfall. The major regions throughout the country have characteristically similar rainfall, day length and thermal pattern during the growing season except for certain highland areas such as Cameron Highlands in Pahang and Kundasan in Sabah where crops such as tea and other temperate crops that grow well in cooler environments are grown.

The soils in Malaysia can be divided broadly into 2 main groups:

(a) **Sedentary soils** formed in the interior on a wide range of rock types, and (b) the **soils of the coastal alluvial plains** (Nieuwolt et. al., 1982). The sedentary soils are derived from igneous, sedimentary and metamorphic rocks and are strongly weathered with mostly kaolinitic clay minerals. The sedentary soils are classified under the order of Nitosols, Acrisols, and Ferralsols (Utisols, Oxisols). Most of the sedentary soils with topography up to 20 deg are cultivated with perennial crops such as oil palm, rubber cocoa, spices and fruit trees. The coastal alluvial soils come under the categories Gleysols, Cambisols, Podzols (Entisols, Inceptisols, Spodosols) and can be grouped into four main types of soils as follows:

(1) The predominantly fine-textured clay and clay loam soils covering large areas of the west coast of Peninsular. Soils in the east coast consist mainly of kaolinitic clay and are relatively coarse textured. Clay loam soils can also be found in small areas in Sarawak.
(2) The peat and organic soils totaling about 2.7 million hectares of which 1.66 million hectares in Sarawak, 984,000 hectares in Peninsular and 86,000 hectares in Sabah. This represented about 8% of the total land area in the country. The limitations of peat soils are low pH(3.0 – 4.5), low base saturation of Calcium and Potassium, low in nutrients Nitrogen, Sulphur, and Molybdenum, and deficient in micronutrients such as Boron, Copper, and Zinc. Despite of these chemical limitations and the physical limitations of low bulk density, vast areas under these soils have been cultivated with oil palm, especially in Sarawak where peat soils are abundant.
(3) The acid sulphate soils scattered along the west coast plains of Peninsular and the Sarawak River, covering about 100,000 hectares. Pyrite can be as high as 10% at the 0.25 - 1.0 m depth, water soluble iron of 400 ppm when submerged for 2 weeks, very acidic (pH 2.7 -3.3) with exchangeable Aluminium 5 -25 meq/100g soil.

(4) The sandy soils (bris soils) spreading along the east coast states of Peninsular and coastal areas of Sabah of approximately 200,000 hectares with 155,400 hectares in Peninsular and 40,400 in Sabah. Bris soils contain 82-99% sand particles (mainly quartz) and have a low cation exchange capacity of 9.53 meq/100g with pH 4.3-4.4.

The peat, acid sulphate and bris soils are considered problem soils and are difficult to manage when crops are cultivated.

The UNDP/World Meteorological Organization conducted a project based on the 30 years climatic records and have successfully mapped out 12 agroclimatic zones of Peninsular, Sabah and Sarawak which included 15 major crops (Anon,1992). The study took into account the rainfall records and distribution, physical constraints, soils and crop suitabilities.

Oil palm and rubber are the major agricultural enterprises over the country with the exception of the highlands and in areas where there are four consecutive dry months. The most suitable climate for mango and sugarcane is found in the northern state of Perlis, in Kudat, parts of Tenom and some interior areas of Sabah and Sarawak.

Pineapple is cultivated in small areas in Ranau, Tawau, Kudat, north of Niah Suai Sibuti and in Pontian at the southern part of Johore in Peninsular. Durian is suited in more hilly areas of Penang, Perak, Pahang and Johor in Peninsular, and Niah Suai Sibuti in Sarawak Banana is found in Jelebu, Tangkak and scattered along the coastal alluvium of the Peninsular. It is also grown in Tawau, Sandakan, Patai Barat and Keningau in Sabah, Batu Kawa and spreading to the other parts of Sarawak

Double cropping of rice cultivation occur only in Kedah, Kelantan, coastal areas of Seberang Perak and in Selangor (Tanjung Karang and Sekinchan). The other areas cultivated with rice are scattered areas in Sabah, in Batu Kawa, Bintulu and Niah Suai Sibuti in Sarawak.

Cocoa which requires partial shade and rich soils are mostly found in Sabah with volcanic soils (Tawau, Sandakan, Keningau and Ranau). Most of the areas under cocoa have been replanted with oil palm which has less problems with pest and diseases and is easier to manage. Similarly, areas under cocoa in Peninsular have also been converted to oil palm. Coconut, a largely a smallholder crop is found mostly along the coastal plains on alluvial soils. These areas have also been replanted with oil palm and their acreage has shrunk over the years.

Tobacco is only cultivated in the northeastern state of Kelantan and the area have since remained unchanged. Vegetable crops (leafy and fruity) are grown in scattered areas by small holders in both highlands and lowland areas in most states.

THE FERTILIZER SECTOR

Mineral fertilizers

In all types of farming system in Malaysia, mineral fertilizers account for more than 90 percent of the fertilizers used. The common fertilizers for both imported and locally

manufactured for use are urea, ammonium sulphate, phosphate rocks, potassium chloride, ammonium phosphates, kieserite and other magnesium fertilizers, borate, potassium nitrate, sulphate of potash, NPK compounds, NPK or NK blended and mixtures fertilizers. The total value of imported fertilizers in 2004, 2005 and 2006 averaged about RM 2.50 billion. When the prices of fertilizers increased in 2007 and 2008, the value of the imported fertilizers increased significantly to RM 5.83 and RM 9.17 billion, respectively (**Table 5**). The prices of most fertilizers hit the peak in mid 2008. Prices of nitrogenous and phosphate fertilizers soften in the third quarter of 2008 while prices of MOP still remained high throughout the year. The demand for fertilizers was very good in 2008 when the commodity prices were very strong up to the third quarter when the CPO prices began to erode to the lowest levels since 2005. Under such market conditions, most oil palm growers held back their manuring programme while waiting for the fertilizer prices to come down. As such, the demand for fertilizers was at its lowest over the same period and this impacted the fertilizer industry for about 5 months. The fertilizer sales only started to improve after the first quarter of 2009 when the CPO prices improved and fertilizer prices were lower. The trend and record of CPO prices for Malaysia from 2005 to August 2009 is shown in **Figure 1** (MPOB, 2009).

Organic fertilizers

The use of organic fertilizers for various crops has gained popularity due to the promotion by the government for more sustainable use and better management of natural resources. Organic agriculture is also being identified as a niche market opportunity for the vegetables and fruits under the National Agricultural Policy 3. The government has put in effort to promote programmes that encourage the recycling and use of agricultural wastes and other biomass. These include rice straw and husk, empty oil palm fruit bunches, animal droppings, saw dust and palm oil mill effluent (POME).The use of these organic products will also reduce the dependence on mineral fertilizers which are now more expensive. With continued use, the soil fertility will also improve. The move towards more natural and healthier methods of food production have gained good acceptance. The Ministry of Agriculture is actively promoting organic farming through their programmes of certification under Standard Organic Malaysia (SOM) and target to increase the organic production areas in the country. The number of local manufacturers of these organic fertilizers has also increased over the last few years to supply to the vegetable and fruit crop areas. More recently, organic fertilizers fortified with chemical fertilizers have also been marketed into the plantation crop sectors.

Production and marketing of fertilizers

Most of the fertilizers used in Malaysia are imported. Urea, ammonium based and organic fertilizers are produced in large quantities but the urea used in Malaysia is not locally produced material. The prilled urea produced in Malaysia fetched a better price and are therefore exported to the international market. The local manufacturer has two subsidiaries involved in the production of urea. These are located in:

(1) Bintulu, Sarawak with a production capacity of about 600,000 tonnes granular urea and 420,000 tonnes prilled urea per year.
(2) Gurun plant, Kedah exports about 65% of its annual production capacity of 650,000

tonnes granular urea and the balance is normally sold to the National Farmers' Association Malaysia for distribution. The major importing countries for Malaysian urea were Thailand, Australia, Japan ,India and the Philippines

Most of the local fertilizer companies are involved in mixing, bulk-blending and production of compound fertilizers. The fertilizer industry in Malaysia is efficient and highly competitive. The normal channels of fertilizer distribution in Malaysia are shown in **Figure 2**. The government, in its effort to help farmers, particularly the smallholders, to procure fertilizers has:

- Stimulated fertilizer consumption through subsidy and credit schemes.
- Facilitated the supply and distribution of fertilizers through RISDA, FELDA, FELCRA and FOA.
- Encouraged proper usage of fertilizers endorsed by MPOB to improve oil palm yields in the smallholder sector.
- Provide extension services and technical advice on Good Agricultural Practices for improve crop yields.
- provide research on fertilizer use and quality control
- Encouraged suppliers to produce smaller packages of fertilizer (e.g. 25 kg bag) for some smallholders who cannot afford the large packings.

Import and export of fertilizers

The import value of fertilizers for Malaysia from 2004 to 2006 averaged about RM 2.50 billion yearly with a drastic increase in 2007 and 2008 at RM5.83 and RM9.17 billion, respectively (**Figure 3** -Agric Directory and Index 2009/10 and FIAM Estimates). However, in 2009, the fertilizers market dampened due to the drastic decline of CPO price starting from July 08 to its lowest in December 08. Oil palm growers held back the fertilizer application in the first quarter of 2009 and reduced in application rate of fertilizers were experienced throughout the first half of 2009. The fertilizer market only started to improve in the second half of 2009 when the CPO prices stabilized.

The proportion of the main nutrients imported such as nitrogen, phosphates, potassium, magnesium and others (NPK compounds, organic and specialty products) in 2004 were 38.8%, 9.5%,41.1%,1.3% and 9.3%, respectively (**Figure 4**). In terms of value, the proportion of potassic and phosphatic fertilizers imported was increased to 47.6% and 16.5% in 2008, respectively. This was due to the substantial increase in price potassic and phosphatic fertilizers and the higher demand for these fertilizers for increased oil palm cultivation for both immature and mature palms. The value of imported nitrogen fertilizers, however, declined from 38.8% to 21.8% due to the relative lower in price increase.

During the last nine years, Malaysian import of urea was quite stable from 2000 to 2003 until an increase in 2004 (about RM282 million) followed by a gradual decrease in 2006 (**Figure 5**). However, the total import of urea in 2008 was substantially increased to RM525 million. The main sources of imported urea were from Indonesia (54.5% valued at RM 286.1 million), China (21.0% valued at RM110.2 million) (**Figure 6**). Urea export by Malaysia, has been trending upward since 2004(RM492.0 million) to 2008 (RM 900.0 million) (**Figure 7**). The major importing countries of Malaysian urea in 2008 were

Thailand (32.5%), Australia (26.8%), Japan (13.5%), India (14.0%) and the Philippines (6.0%)(**Figure 8**).

The year-to-year import of sulphate of ammonia occurred within a tight range of RM415 to RM400 million from 2004 to 2006 and import escalated in 2007 and 2008 due to the drastic increase in price (**Figure 9**). The major sources of import for this fertilizer in 2008 were China (35.5%), Japan (25.0%), Korea (14.0%), Taiwan (10.0%) and Russia (2.0%)(**Figure 10**). The import of ammonium sulphate from China increased from 7.5% to 35.5% from 2004 and 2008, respectively

The import value of rock phosphates fluctuated between RM193.0 to RM117.8 million yearly from 2004 to 2006 and drastically increased to RM755 million in 2007 and RM960 million in 2008(**Figure 11**). The major countries supplying to Malaysia in 2008 were Egypt, Tunisia, Christmas Island, Australia and Algeria, with values in proportion of 28.0%, 22.5%, 19.0%, 16.0% and 14.5%, respectively (**Figure 12**).

The import of muriate of potash was traded at about RM1.0 billion in 2004 and 2005. The import value increased after 2005 due to increase usage for oil palm cultivation and higher prices of the potassic fertilizers. In 2006, 2007 and 2008, the increased import of MOP was valued at RM1.30, RM2.65 and RM3.53 billion, respectively (**Figure13**). Canada is the largest supplier of MOP which accounted for 35% of the Malaysia's import of MOP in 2008(**Figure 14**). Russia and Jordan are the other exporters of MOP to Malaysia and contributed to 25.5% and 13.0%, respectively.

The import of NPK compound fertilizers fluctuated from RM225 to RM227.2 million from 2004 to 2006 (**Figure 15**). However, the import value of these NPK compounds increased sharply to RM653.4 and RM1,190 million in 2007 and 2008, respectively. This is attributed to the increase in both volume as well as the higher prices of the compound fertilizers. The three major sources of import for NPK compounds into Malaysia in 2008 were Korea, Belgium and Russia which contributed to 27.5%, 21.0% and 12.5%, respectively (**Figure 16**).

The overall market for all imported fertilizers declined significantly both in terms of quantity and value of the fertilizers in 2009. The quantity of the imported fertilizers reduced as a result of higher stocks of fertilizer in the last quarter of 2008 which was carried over to 2009. The value of the imported fertilizers for 2009 also reduced considerably as a result of falling prices of most fertilizers.

FERTILIZER CONSUMPTION BY CROPS

The estimated total volume and value of fertilizers imported for use in production of industrial, fruits, vegetable and other crops from 2004 to 2008 for Malaysia are shown in **Tables 6**. **Table 7** showed the area of cultivation for these crops from 2004 to 2008. Based on the official recommended rates of fertilizer use, the yearly nutrient consumption for each of the crops can be estimated (**Table 8**). According to the figures, on average in 2007 and 2008, the industrial crops accounted for 96.50% of the total nutrient use, fruit crops for 2.65%, vegetable crops for 0.45% and other cash crops for the remainder.

Industrial crops

The industrial crops of Malaysia include oil palm, rubber, cocoa, rice, coffee, tea, sugarcane, tobacco and coconut. In 2008, these crops occupied 6.6 million hectares (96.2% of the total cultivated area of 6.86 million Hectares). **Tables 9** showed the harvested areas and the estimated average crop yields for 2002, 2007 and 2008 which was the years selected for the paper. **Tables 10** showed the calculated use of N, P_2O_5 and K_2O on each of the selected industrial crops which showed that oil palm is by far the largest consumer of fertilizer. The consumption has been increasing rapidly with rapid expansion of crop areas. However, the fertilizer use for cocoa and rubber has been declining as these areas have been replanted with oil palm throughout the country. The total consumption for N, P_2O_5 and K_2O in 2008 for oil palm, rubber and cocoa was 1.29, 0.14 and 0.042 million tonnes, respectively. Rice was the third largest fertilizer consumer among this group of industrial crops, but accounted only 6.8% of the consumption of oil palm. The area under tobacco(flue-cured Virginia) which is concentrated in the north eastern states of Kelantan and Trengganu have also declined from 15,600 hectares in 2002 to an estimated area of 6,700 hectares in 2008, representing a drop of about 57%(National Tobacco Board statistics). A small area of 1,000 hectares of Burley type tobacco cultivation in Sabah has been reported in 2007. The estimated consumption of fertilizers for tobacco in Peninsular and Sabah. Sugarcane is mainly grown in the northern states of Kedah and Perlis which have a distinct dry weather conditions that favour the growth and production. The area under this crop has stagnated at about 14,370 hectares in Peninsular and about 300 hectares in East Malaysia in 2008.

Fruit crops

The 12 most important fruit crops with their planted areas by state and production are shown in **Table 11**. Durian represented the largest fruit crop planted in the country with 112,568 hectares in 2002 but the area has declined to 107,507 hectares in 2008. This is due to the uncertainty of profitability and some growers have converted their orchard to oil palm. The production of the major fruits in Malaysia peaked in 2007and 2008 with about 23.2 million tones per year. There is a general upward trend in local fruit production in the country from 2007 with the government emphasis to reduce importation of temperate fruits. The total area under fruit cultivation in 2008 was 226,709 hectares which represented 3.4% of the total cultivated area in the country. In terms of production, pineapple, together with durian, banana and watermelon accounted for 1.13 million tones in 2008. The summary in **Table 12** showed that banana is the largest consumer of fertilizer and starfruit is the smallest. The Malaysian starfruit is popular for the export market to Hongkong and Europe. The major fruit crops planted for the export market are watermelon, papaya and banana. Other fruit crops which are seasonal in terms of production and shorter shelf-life are mainly for local consumption and export to neighboring countries.

Vegetable crops

In 2008, the vegetable crops in total occupied 22,630 hectares (**Table 13**) which represented 0.33% of the total cultivated area of about 6.86 million hectares in Malaysia. The paper focused on 6 major vegetable crops such as Chinese spinach, lady's finger,

chilli, long bean, cucumber and tomato. The consumption of fertilizers for the relevant vegetable crops is summarized in **Table 14**. The largest consumer of fertilizers for vegetable crop is chilli and Chinese spinach the smallest. There is also an upward trend to produce more vegetable crops to feed the increase population in the country. Over the last 3 years, the area of intensive cultivation of fruit vegetable under plastic shelter with modern fertigation techniques, especially tomato and capsicum have increased rapidly in the cool highland areas of Pahang and Kelantan state. The use of imported soluble fertilizers such as potassium nitrate, mono potassium phosphates, sulphate of potash, calcium ammonium nitrate and micronutrients have also increased. Malaysia continues to import fresh vegetables from China, Indonesia, USA and Australia to meet local consumption as farm labour and production costs are escalating.

Pepper and other cash crops

Area under pepper (mostly in Sarawak) has been on a declining from 2002 due the drastic drop in the prices. The crop is grown mostly by small holders and the highest area planted was 13,900 hectares in 2002. Since then, the area under pepper cultivation has declined to 11,900 and 12,000 hectares in 2007 and 2008, respectively.

The other cash crops grown on a smaller scale includes sweet potato, cassava and groundnuts (**Table 15**). The estimated consumption of fertilizers for these crops in 2002, 2007 and 2008 are summarized in **Table 16**.

ECONOMIC RETURNS FROM USE OF FERTILIZERS

Smallholders are usually ready to use fertilizers that are readily available to them and, most importantly, if they are affordable and their use is profitable. There is no problem for them to buy the fertilizers as there are many dealers scattered over the country. The market for fertilizers is open and very competitive with many suppliers and dealers but prices have been rising in line with international market prices. The government helps small rice farmers with fertilizer subsidies in order to improve their farm income and hence alleviate rural poverty.

The farm gate prices of selected crops for 2007 and 2008 with comparison with 2002 are shown in **Table 17**. The market prices of some straights and compound fertilizers in 2002, 2007 and 2008 in Peninsular Malaysia (**Table 18**) have doubled from 2002 to 2007. The prices of fertilizers almost reached the peak prices in 2007 to mid 2008 when commodity prices are also at their peak. The commodity prices especially for rubber and oil palm have also doubled over the same period. The profitability of these commodity crops cultivated may not be impacted when compared with the fruit and vegetable crops where the farm gate crop prices have generally increased by a smaller proportions.. Among the industrial crops, in 2007, rubber and oil palm fetched the highest market price followed by cocoa. For the fruit crops, in 2007, starfruit and watermelon were the most and the least expensive, respectively. Among the selected vegetables for the same year, chilli and cucumber were the most and the least expensive, respectively. However, when the prices of palm oil and rubber declined in first quarter of 2009, the prices of fertilizers also weakens. Generally, prices of Nitrogen and Phosphorus have declined in 2009 while price of Potassium is still at high levels.

The large commercial plantations use compounds, mixtures, blends and straight fertilizers for the industrial crops. These plantations usually have their yearly budgeted fertilizer programmes to achieve the targeted yields and profits. When commodity prices are low, fertilizer withdrawal or reduction is often practiced. When commodity prices are good, these plantations will switched to the use of more compound fertilizers to take advantage of labour saving and ease of applications. The success rate of completion of the annual manuring programme using more application rounds of straight fertilizers are lower under our local weather conditions..

The rapid expansion of oil palm cultivation in both Peninsular and East Malaysia (Sabah and Sarawak) over the years has encroached into soils with lower productivity (hilly and inland soils) and more problematic soils (e.g peat soil in Sarawak) (Hashim and Mohd Ali, 2006). Under these difficult soils, climatic conditions and different cultivation practices, the fertilizer inputs become even more important to achieve higher crop productivity. In order to be competitive, Malaysia has to continue its effort to improve crop productivity per unit area with improved soil fertility and good agronomic practices in the right direction for both the smallholders and the plantation groups. Based on our analysis, the oil palm growers who achieved high crop yields are those who practiced regular fertilizer applications over the years and consistently adopting better field management. They also achieve profits during the low and high oil palm prices because of their uniformly higher crop yields over the years. Many growers and plantations over the years and even recently in early 2009 withdrew or reduced fertilizer inputs when the oil palm prices were low. This is because fertilizer is the most expensive inputs in the costs of production. However, the production of palm oil differ from other mass production processes as the palms cannot be turned on and off in accordance with the market conditions and variable fertilizer schedule. The reduction of fertilizers results in significant crop reduction in the subsequent years as demonstrated in trials by MPOB (Mohd Tayeb and Tarmizi, (2001). Mohd Noor et.al.(2005) concluded in their study that the slow recovery of oil palm productivity would following fertilizer withdrawal affects the profitability when CPO prices increase in the subsequent years. The result of lower productivity would deny the growers to harvest the benefits that culminate from improving CPO prices. In fact, the grower suffers low marginal revenue during the low oil palm prices and low crop production when good prices returned.

Since the plantation industry is a business investment, the economic value of a fertilizer has to be assessed before purchase for use. A cheaper fertilizer may not necessarily provide the efficient source of the nutrient required for healthy palm growth. Examples are the common sources of Mg fertilizer which have different solubilities and effectiveness to supply the available Mg required by the palm.

An expensive fertilizer may be more economical to use if its agronomic efficiency far outweighs into price ratio compared to the alternatives. Profit considerations must be given top priority and economic efficiency of the fertilizer must always be considered. A poorer quality fertilizer which has lower uptake by the palm will result in poor utilization resulting in lower crop production.

THE FUTURE TREND OF FERTILIZER USAGE

It is expected that the usage of mineral fertilizers will continue to increase with the expansion and intensification of cultivated areas in Malaysia. If the commodity prices improved in 2009 and into the 2010, the demand for mineral fertilizers will increase in tandem with the expansion of the industrial crops especially oil palm and rubber. Palm oil is the key agricultural commodity in Malaysia, and is the leading global source of vegetable oil. Analysts have predicted that the demand for palm oil will double within the next few decades and this will continue to drive the expansion of oil palm in Malaysia and Indonesia (Gan, 2009). However, with emerging technologies such as precision agriculture with more site-specific management that are being practiced and increase effort of recycling of organic biomass into the plantations, there is a possibility of some fertilizer rate reduction especially for oil palm. These are now being actively promoted through the Roundtable on Sustainable Palm Oil Production (RSPO) with the opportunity for oil palm producers to reduce global pressure on numerous issues on social and environmental concerns. Plant breeders should explore possibilities of producing crops, which are high yielding and lower demand for nutrients. Agroforestry, intercropping, integrated farming systems (animals and crops) and the use of organic wastes such as empty fruit bunches, palm oil mill effluent (POME) and animal dungs would reduce the dependence on mineral fertilizers.

Since fertilizer inputs are the most expensive cost component of the production of oil palm, proper implementation of an effective fertilizer programme is very important to ensure profitability. The procedures, in planning and organizing fertilizer application must be strictly adhered to. Fertilizer application programme with the right quantity of fertilizers required by the various fields of planting, transport and labour must be planned and organized ahead to ensure smooth and efficient implementation throughout the manuring programme. This is of particular significance to large plantations in East Malaysia which encounter more problems associated with logistics and transportation, poorer infrastructures, labour constraints and unpredictable weather conditions. In order to stay competitive in this industry, proper implementation of an effective fertilizer management programme and good agronomic practices is very crucial in the long term.

With the vast expansion of oil palm cultivation and the growing constraints of labour, use of controlled release fertilizers for oil palm nurseries and planting hole application in East Malaysia has also become more attractive.

With the increasing demand for palm oil as a globally competitive vegetable oil and the related downstream products, area under oil palm cultivation will increase. This will generate higher demand for fertilizers in this industry for Malaysia. The potential for usage of NPK compound fertilizers will be greater as they have the advantage of the benefits such as labour saving, effective uptake to provide more balanced nutrition, ease of handling, storage and field application. The use of high K compounds is also becoming more popular for mature oil palm under peat soils with high demand for potassium. Incorporation of micronutrients such as copper, zinc and boron into these compounds for both immature and mature oil palm should be explored for this growing market for Sarawak in particular. Development and improvement in fertilizer management is essential to achieve the desired goals of sustainable good crop yields in the near future.

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Table 1: Agriculture's contribution to the GDP; 1990 -2009 (based on 1987 constant price)

YEAR	GDP RM million	GDP Annual Growth Rate	Agriculture* RM million	Share of GDP
1990	79,155	9	14,821	18.72
1995	166,625	9.4	17,155	10.72
2000	209,959	8.9	18,062	8.6
2005	449,250	5.3	35,835	2.6
2006	475,192	5.8	37,769	5.4
2007	505,353	6.3	38,593	2.2
2008(p)	528,804	4.6	40,073	3.8
2009(f)	528,860	0	39,260	-2

Sources: Economic Planning Unit, Ministry of Finance and Bank Negara Malaysia; Malaysia Agricutural Directory and Index 2009/2010

* includes forestry and fishery (p) preliminary (f) forecast

Table 2: Agricultural land use, 1995-2010

Crop	Hectares ('000)			
	1995	2000	2005	2010
Oil Palm	2,508	3,377	4,051	4,555
Rubber	1,727	1,431	1,250	1,179
Padi *[1]	480	478	452	450
Fruits	244	304	330	375
Coconut	273	159	121	180
Cocoa	234	76	33	45
Vegetables	42	40	64	86
Tobacco	10	15	10	7
Pepper	10	13	13	14
Total*[2]	**5,528**	**5,893**	**6,324**	**6,891**

Source: Ministry of Agriculture & Agro-Based Industry and Ministry of Plantation Industries and Commodities.

Notes: *[1] Based on padi parcel, *[2] Excludes areas for other crops like tea, coffee and herbs as well as aquaculture

Table 3: Production of agricultural commodities 2000-2010

Commodity	Metric Tonnes('000)			Average Annual Growth Rate (%)		
				8MP		9MP
	2000	2005	2010	Target	Achieved	Target
Rubber	928	1,124	1,293	4	3.9	2.8
Crude Palm Oil	10,842	14,961	19,561	7	7	6
Palm Kernel Oil	1,384	1,868	2,570	5	6	7
Cocoa	70	28	57	-5.7	-16.7	15.5
Paddy	2,141	2,400	3,202	0	2	6
Pepper	24	19	30	6	-5	10
Pineapple	266	408	1,106.00	2	9	22
Tobacco	7	14	12	14	14	-3
Fruits	993	1,586.90	2,555.70	3	10	10
Vegetables	404	771	1,133.30	1	14	8
Coconut	476	602	660.00	1	5	2
Flowers*[1]	120	126	147.30	3	1	3

Source: Ministry of Agriculture & Agro-Based Industry and Ministry of Plantation Industries and Commodities

Note *[1]:Measured in million stalk

Table 4: Recommended fertilizer rates for crops on mineral soils

CROP GROUP	CROP	Rates(kg/ha)			PPD per ha	Recommending Agency*
		N	P_2O_5	K_2O		
Industrial	Rubber	110	164	280	450	MRB
	Coconut	72	93	108	239	DOA
	Oil-Palm	128	144	200	138	MPOB
	Cocoa	117	55	140	1,241	DOA
	Coffee	134	63	160	1,280	DOA
	Paddy	90	35	25	500(m2)	DOA
	Sugarcane	100	118	140	-	FELDA
	Tea	95	75	120	-	DOA
	Tobacco	80	205	130	17,932	DOA
Fruits	Starfruit	117	117	165	278	DOA
	Papaya	84	84	119	2,000	DOA
	Cempedak	118	118	127	123	DOA
	Durian	98	98	150	100	DOA
	Sweet orange	100	100	143	400	DOA
	Mangosteen	118	118	167	178	DOA
	Mango	82	82	126	158	DOA
	Pineapple	297	297	352	36,900	DOA
	Jackfruit	50	50	73	130	DOA
	Banana	554	554	680	1,680	DOA
	Rambutan	73	73	104	170	DOA
	Water melon	84	84	59	2,000	DOA
Vegetables	Chinese spinach	60	60	85	-	MARDI
	Lady's fingers	120	120	170	5,487	DOA
	Chilli	180	180	255	8,570	DOA
	Long bean	84	84	119	21,333	DOA
	Cucumber	60	60	85	21,333	DOA
	Tomato	180	180	255	21,333	DOA
Spices	Hot chilli	135	35	75	-	DOA
	Ginger	180	180	255	53,797	MARDI
	Pepper	299	135	411	1,680	DOA, Sarawak
Cash crops	Maize	130	57	130	53,333	DOA
	Groundnut	27	55	45	-	MARDI
	Cassava	30	15	55	10,000	MARDI
	Sweet potato	120	120	170	-	DOA

PPD = Plant density
* DOA represent Peninsular Malaysia's Department of Agriculture unless otherwise stated
Source: FAO Publication 2004. Fertilizer use by crops in Malaysia.

Table 5: Malaysian fertilizer imports 2004 – 2009

Year	Value RM'000
2004	2,422,120
2005	2,350,758
2006	2,650,861
2007	5,835,952
2008	9,171,000
2009(f)	3,395,100

Sources: Department of Statistics; FIAM and Industry's estimates

Table 6: Quantities (metric tonnes) and value (RM '000) of imported fertilizers for Malaysia 2004-2009

Fertilizers	2004		2005		2006		2007		2008		2009 (Probable)	
	Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value
Ammonium sulphate	809,138	415,111	766,764	422,635	1,037,247	466,650	800,000	800,000	850,000	1,020,000	700,000	385,000
Ammonium chloride	199,728	89,610	224,466	71,581	180,000	72,000	211,865	148,400	250,000	375,000	210,000	107,500
Ammonium nitrate	214,342	153,320	568,161	133,346	105,909	62,702	55,131	102,467	100,000	140,000	80,000	48,000
Urea	353,812	281,898	322,319	294,540	271,244	223,190	235,000	502,900	250,000	525,000	220,000	209,000
DAP/TSP	32,000	48,500	57,000	91,200	45,000	82,000	45,000	134,791	40,000	1,280,000	30,000	60,000
Rock phosphates	546,079	193,000	406,963	100,211	427,229	117,893	795,900	755,250	800,000	960,000	600,000	300,000
MOP	1,459,945	994,263	1,097,611	923,855	1,450,000	1,305,000	1,395,000	2,650,500	1,400,000	3,528,000	1,050,000	1,890,000
SOP	1,931	1,987	2,524	2,942	2,973	3,856	2,285	8,515	2,500	9,000	1,800	3,600
NPK compounds	271,078	225,431	329,934	256,942	244,800	227,216	297,021	653,446	350,000	1,190,000	200,000	340,000
Kiesierite/related Mg	85,896	39,000	97,285	53,506	116,702	45,354	110,932	76,683	120,000	144,000	80,000	52,000
Total	**3,973,949**	**2,442,120**	**3,873,027**	**2,350,758**	**3,881,104**	**2,650,861**	**3,948,134**	**5,832,952**	**4,162,500**	**9,171,000**	**3,171,800**	**3,395,100**

Table 7: Total area of crop cultivation in Malaysia 2004-2008

Crops	(' 000 Hectares)				
	Year				
	2004	2005	2006	2007	2008
Industrial crops					
Rubber	1,268	1,259	1,251	1,230	1,280
Oil palm	3,875	4,051	4,165	4,304	4,488
Cocoa	44.9	33.4	31.33	28.15	20.59
Coconut	143.09	121.01	119.47	117.65	115.84
Sugarcane	14.73	14.24	14.68	14.67	14.67
Tobacco	12	11	7.94	8	6.7
Coffee	9.96	8.53	7.52	7.1	6.67
Tea	2.03	1.77	3.32	2.78	2.77
Rice(Paddy)	667.3	666.78	676.03	676.11	670.52
Fruit crops					
Starfruit	1.17	1.1	1.11	1.13	1.15
Papaya	2.7	2.76	2.12	2.14	2.16
Chempedak	11.78	11.3	10.68	11.11	11.55
Durian	115.68	110.62	105.39	106.44	107.51
Citrus	6.6	5.17	5.17	5.28	5.38
Mango	9.17	9.42	10.02	10.12	10.22
Mangosteen	7.37	7.68	7.41	7.49	7.56
Pineapple	9.31	14.88	14.14	14.43	14.72
Jackfruit	3.24	3.13	3.12	3.22	3.31
Banana	29.06	28.02	26.86	27.39	27.44
Rambutan	25.73	25.32	24.93	25.43	25.94
Watermelon	7.39	8.69	9.21	9.49	9.78
Vegetable crops					
Sawi	7.91	6.63	7.17	7.2	7.44
Lady's finger	1.79	1.69	1.57	1.58	1.59
Chilli	2.18	3.3	3.14	3.25	3.38
Long bean	2.99	2.86	3.32	3.42	3.52
Cucumber	2.68	2.91	3.01	3.13	3.25
Tomato	0.92	0.99	1.9	2.55	3.55
Cash crops					
Maize	5.46	6.5	6.56	6.62	6.69
Groundnut	0.31	0.29	0.24	0.22	0.2
Cassava	1.47	1.93	2.35	2.51	2.68
Sweet potato	1.14	1.32	1.99	2.39	2.87

Sources: Ministry of Agriculture & Agro-based Industry, Malaysian Palm Oil Board, Lembaga Getah Malaysia and Lembaga Koko Malaysia.

Table 8: Estimated fertilizer nutrients consumption by crop groups for Malaysia ('000 tonnes)

Crop groups	Nitrogen (N)			Phosphorus (P_2O_5)			Potassium(K_2O)		
	2002	2007	2008	2002	2007	2008	2002	2007	2008
Industrial crops	270	360	387	213	284	310	572	805	842
Fruit crops	8.1	10.8	11.6	8.5	10	11	16	19	19
Vegetable crops	1.2	1.8	1.9	1.1	1.9	2	1.5	2.4	2.3
Cash crops & pepper	1.4	1.9	2	0.8	1.2	1.3	1.4	1.9	2
Total	**280.7**	**374.5**	**402.5**	**223.4**	**297.1**	**324.3**	**591.1**	**826.4**	**865.6**

Table 9: Industrial crop area (' 000 Ha) and crop yield (tonnes/Ha) for 2002, 2007 and 2008

Crops	Crop area ('000 Ha)			Crop yield (tonnes/Ha)		
	2002	2007	2008	2002	2007	2008
Oil Palm	3,670	4,304	4,488	18	19	20
Rubber	1,350	1,230	1,280	1	1	1
Rice	667	676.11	670.52	3.4	3.51	3.56
Coconut	145.1	117.7	115.8	2.91	4.29	4.29
Sugarcane	15.2	14.67	14.67	57.5	50	50
Tobacco	15.6	8	6.7	6.63	6.5	4.3
Cocoa	47.5	28.2	20.6	0.95	1.25	1.35

Sources: MPOB, LGM, LKM, LTN and Department of Agriculture

Table 10: Estimated consumption of nutrients for industrial crops for 2002,2007 and 2008 (' 000 tonnes)

Crops	Nitrogen (N)			Phosphorus (P)			Potassium (K)		
	2002	2007	2008	2002	2007	2008	2002	2007	2008
Oil palm	180	272	300	153	230	252	470	704	737.4
Rubber	40.7	37.6	38.5	35	30	35	66	65	68
Rice	42.2	45	44	16	16	16	25	27	28
Coconut	2.2	1.6	1.5	5	4.7	4	3	2.5	2.8
Sugarcane	1.2	1.2	1.2	1.5	1.5	1.5	2.5	2.5	2.8
Tobacco	1.2	0.8	0.6	1	0.8	0.5	2	1.5	1
Cocoa	2.5	1.8	1.2	1.5	1	1	3.5	2.5	2
Total	**270**	**360**	**387**	**213**	**284**	**310**	**572**	**805**	**842**

Table 11: Fruit crop area (Hectares) and crop yield (kg/Ha) for 2002, 2007 and 2008

Crops	Crop area (Hectares)			Crop yield (kg/Ha)		
	2002	2007	2008	2002	2007	2008
Starfruit	1,184	1,131	1,153	9,236	9,198	9,203
Papaya	2,854	2,138	2,160	14,894	16,366	16,362
Cempedak	11,894	11,106	11,550	4,124	4,200	4,218
Durian	121,568	106,442	107,507	3,543	3,500	3,500
Citrus	6,945	5,178	5,383	4,859	4,500	4,500
Mango	9,089	10,117	10,219	2,935	3,000	3,000
Mangosteen	7,386	7,488	7,563	3,208	3,900	3,900
Pineapple	9,126	14,427	14,716	21,023	22,000	22,000
Jackfruit	3,146	3,217	3,314	5,639	6,000	6,000
Banana	28,485	27,392	27,438	10,045	9,679	9,680
Rambutan	25,954	25,427	25,936	3,036	2,795	2,795
Watermelon	7,890	9,495	9,770	15,568	17,000	17,000
Total	**235,521**	**223,558**	**226,709**	**98,110**	**102,138**	**102,158**

Source: Ministry of Agriculture and Agro-Based Industry Malaysia

Table 12: Estimated consumption of nutrients for fruit crops for 2002, 2007 and 2008 (tonnes)

Crops	Nitrogen(N)			Phosphorus(P)			Potassium(K)		
	2002	2007	2008	2002	2007	2008	2002	2007	2008
Starfruit	3.7	3.7	5	3.7	3.7	4	7	8	8.5
Papaya	65	70	95	85	68	80	190	196	210
Cempedak	195	203	250	220	203	225	450	413	400
Durian	950	890	920	995	890	900	1,850	1,955	1,960
Citrus	50	55	75	75	48	60	110	104	105
Mango	70	100	130	90	95	104	140	166	165
Mangosteen	40	50	58	50	44	48	85	80	80
Pineapple	1,540	2,780	2,895	1,610	2,605	2,700	3,130	4,805	4,815
Jackfruit	43	57	70	60	56	56	95	100	102
Banana	4,723	5,985	6,425	4,780	5,430	6,250	9,204	10,125	10,190
Rambutan	225	270	295	260	270	275	500	493	435
Watermelon	200	335	370	250	334	345	240	586	530
Total	**8,104**	**10,799**	**11,588**	**8,479**	**10,046**	**11,047**	**16,001**	**19,031**	**19,000**

Table 13: Vegetable crop area (Hectares) and crop yield (kg/Ha) for 2002. 2007 and 2008

Crops	Crop area (Hectare)			Crop yield (kg/Ha)		
	2002	2007	2008	2002	2007	2008
Sawi	7,110	7,200	7,440	13,565	12,300	12,600
Lady's finger	1,400	1,580	1,590	12,700	13,300	13,400
Chilli	2,040	3,250	3,380	11,565	11,000	11,200
Long bean	2,750	3,420	3,520	12,850	13,800	14,000
Cucumber	2,590	3,130	3,150	19,050	18,400	18,600
Tomato	910	2,550	3,550	32,500	40,000	42,000
Total	**16,800**	**21,130**	**22,630**	**102,230**	**108,800**	**111,800**

Table 14: Estimated consumption of nutrients for vegetable crops (tonnes)

Crops	Nitrogen(N)			Phosphorus(P)			Potassium(K)		
	2002	2007	2008	2002	2007	2008	2002	2007	2008
Sawi	365	395	410	355	425	440	380	435	410
Lady's finger	130	160	165	110	180	185	170	225	210
Chilli	265	340	345	240	350	365	310	375	360
Long bean	200	265	270	180	275	285	270	330	310
Cucumber	115	140	140	105	155	150	180	245	230
Tomato	125	500	570	110	515	575	190	790	780
Total	**1,200**	**1,800**	**1,900**	**1,100**	**1,900**	**2,000**	**1,500**	**2,400**	**2,300**

Table 15: Cash crop area (Hectares) and crop yield (kg/Ha) for 2002, 2007 and 2008

Crops	Crop area (Hectares)			Crop yield (kg/Ha)		
	2002	2007	2008	2002	2007	2008
Maize	5,100	6,625	6,689	5,425	5,500	5,600
Groundnut	280	220	203	2,850	3,495	3,596
Cassava	1,345	2,510	2,679	23,450	20,998	21,103
Sweet Potato	1,120	2,390	2,869	14,300	14,499	14,598
Pepper	13,900	11,900	12,000	1,690	2,100	2,095

Table 16: Estimated consumption of nutrients for cash crops(tonnes) for 2002, 2007 and 2008

Crops	Nitrogen(N)			Phosphorus(P)			Potassium(K)		
	2002	2007	2008	2002	2007	2008	2002	2007	2008
Maize	263	409	415	100	135	155	338	488	496
Groundnut	8	8	7	5	5	5	12	12	9
Cassava	42	115	143	22	55	64	50	120	142
Sweet potato	135	316	350	100	250	260	135	310	350
Pepper	952	1052	1085	573	755	816	865	970	1,003
Total	**1,400**	**1,900**	**2,000**	**800**	**1,200**	**1,300**	**1,400**	**1,900**	**2,000**

Table 17: Average farmgate prices of selected crops for 2002, 2007 and 2008

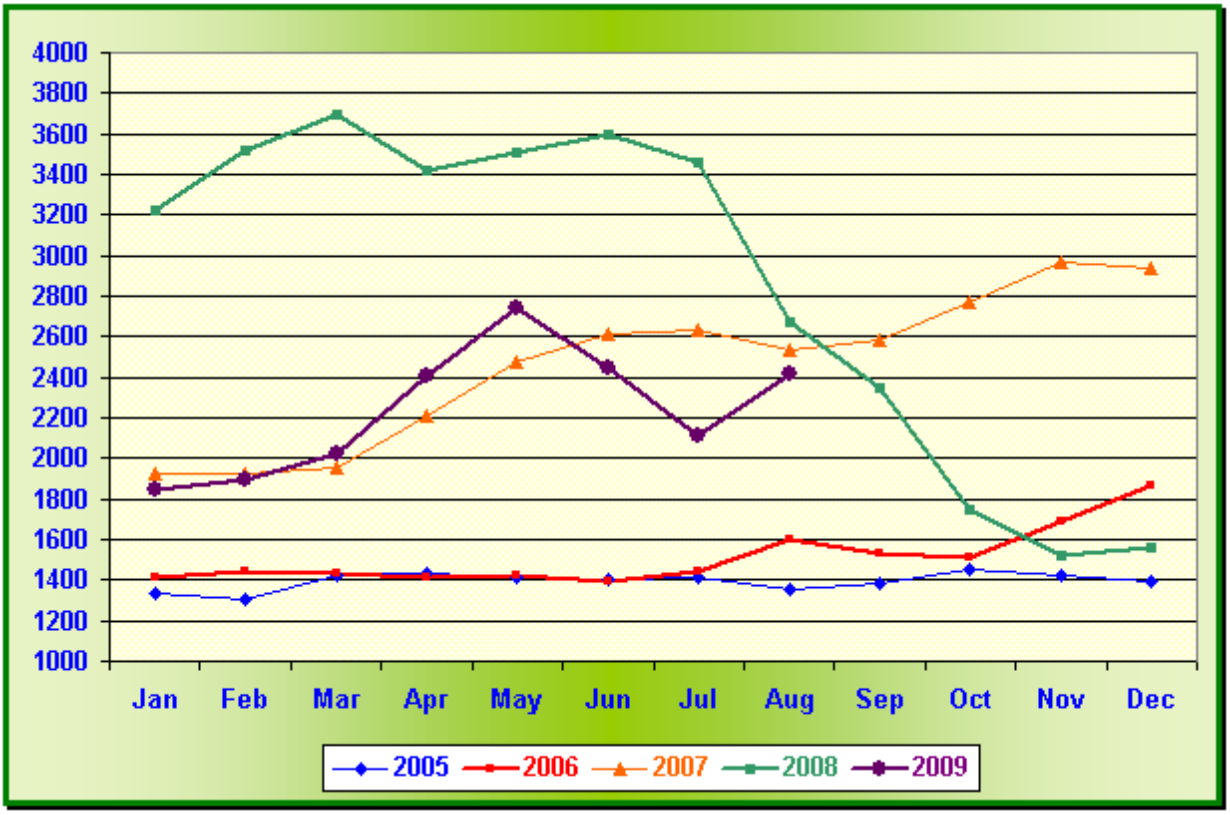
Selected crops	Average farmgate price (RM per tonnes)		
	2002	2007	2008
Industrial crops			
Rubber(SMR 20)	2,850	7,340	8,314
Oil Palm (CPO deld.)	1,363.50	2,530.50	2,777.00
Cocoa(SMC 2 Tawau)	5,611	6,078	8,687
Fruit crops			
Starfruit	1,900	1,850	2,100
Papaya	650	780	950
Durian	1,020	1,150	1,230
Mango	1,700	1,800	1,900
Pineapple	1,100	1,250	1,320
Banana	680	870	980
Watermelon	550	600	720
Vegetable crops			
Sawi	820	1,400	1,450
Lady's finger	1,600	2,100	2,300
Chilli	2,800	4,500	5,100
Long bean	1,150	1,050	1,180
Cucumber	550	850	890
Tomato	1,200	1,800	2,100

Source: Federal Agricultural Marketing Authority (FAMA); Ministry of Agriculture & Agro-based Industry; Malaysian Palm oil Board; Lembaga Koko Malaysia; Lembaga Getah Malaysia

Table 18: Average price range of local compound and straight fertilizers(in 50 kg bag) in Peninsular Malaysia

Fertilizers	Average price range (RM per 50 kg bag)					
	2002	2007	2008	2009(1st Qtr)	2009(2nd Qtr)	2009 (3rd Qtr)
Compounds						
12/12/17/2+TE	45 - 60	65 - 75	125 - 130	130 - 135	115 -120	85 - 90
13/13/20+TE	58 - 62	75 - 85	135 -145	145 - 150	120 - 125	90 - 95
15/15/15	58 - 60	60 - 70	125 - 130	130 -135	110 - 120	80 - 85
15/15/6/4	48 - 62	65 -75	120 -130	130 -135	110 - 115	85 -90
Straights						
CIRP	17 -19	35 - 40	65 - 75	75 - 80	60 - 65	40 - 42
Other RP	20 - 25	50 - 55	68 - 80	80 - 90	65 - 70	42 - 45
SOA	25 - 30	35 - 40	75 - 80	60 - 65	50 - 55	30 - 35
MOP	38 - 40	55 - 65	147 - 155	150 -165	145 -150	100 -105
Urea	55 - 60	65 - 70	145 - 150	110 - 115	95 - 100	85 - 90

Figure 1: Crude palm oil price trend 2005 – 2009



Source: MPOB

Figure 2: Fertilizer sales distribution system

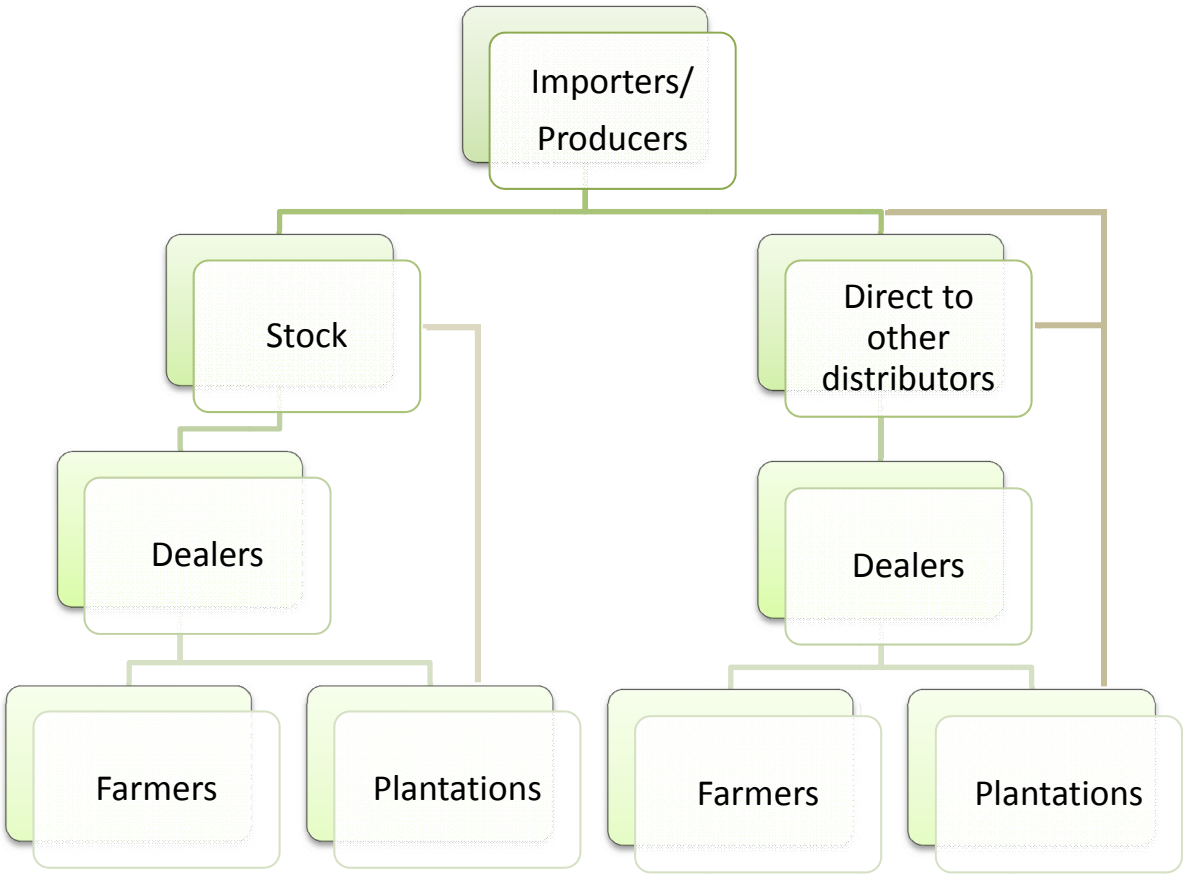
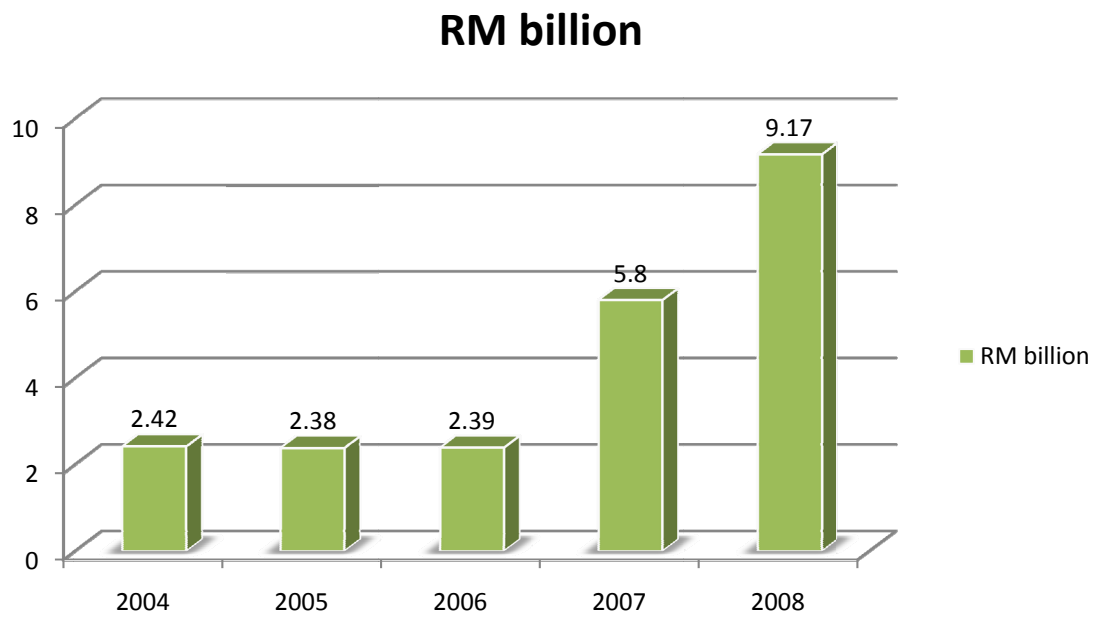
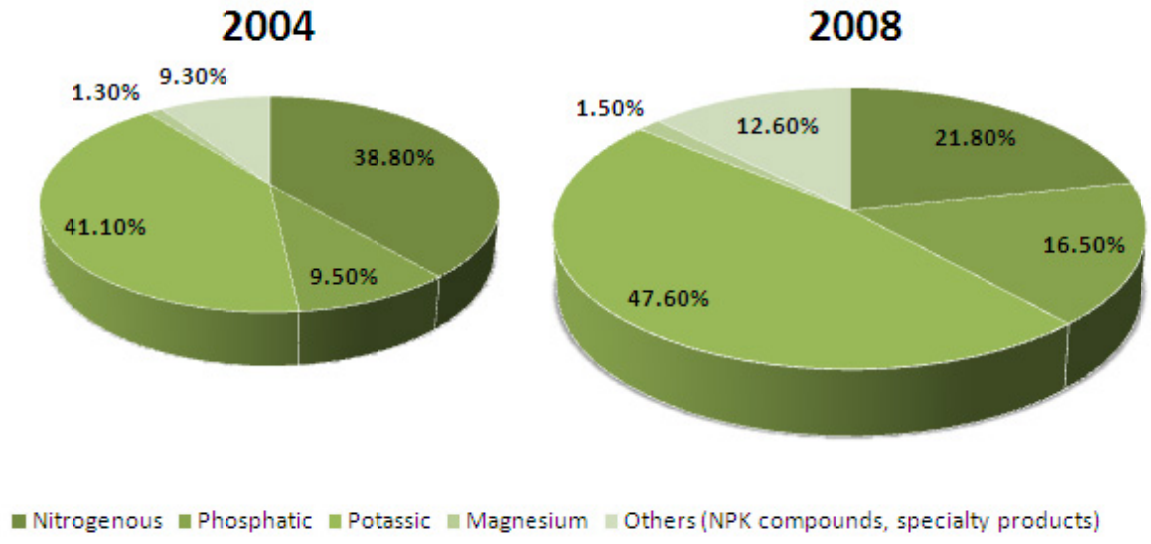


Figure 3: Malaysian fertilizer imports (RM billion), 2004-2008



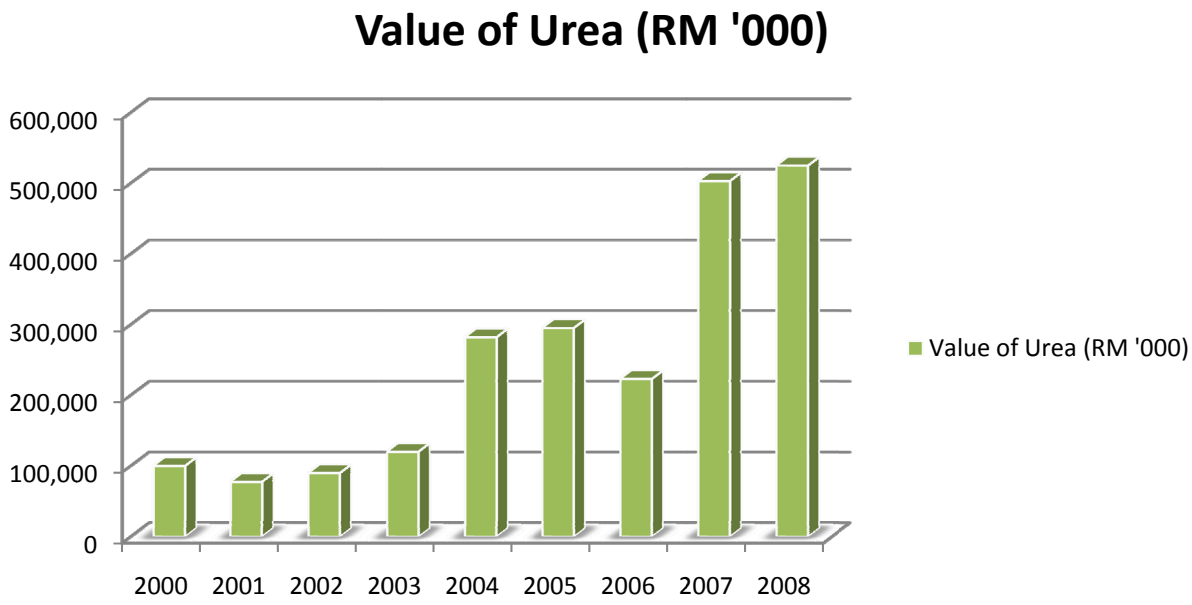
Sources: Department of Statistics; FIAM and industry estimates

Figure 4: Distribution of fertilizer imports by groups (RM million), 2004 and 2008



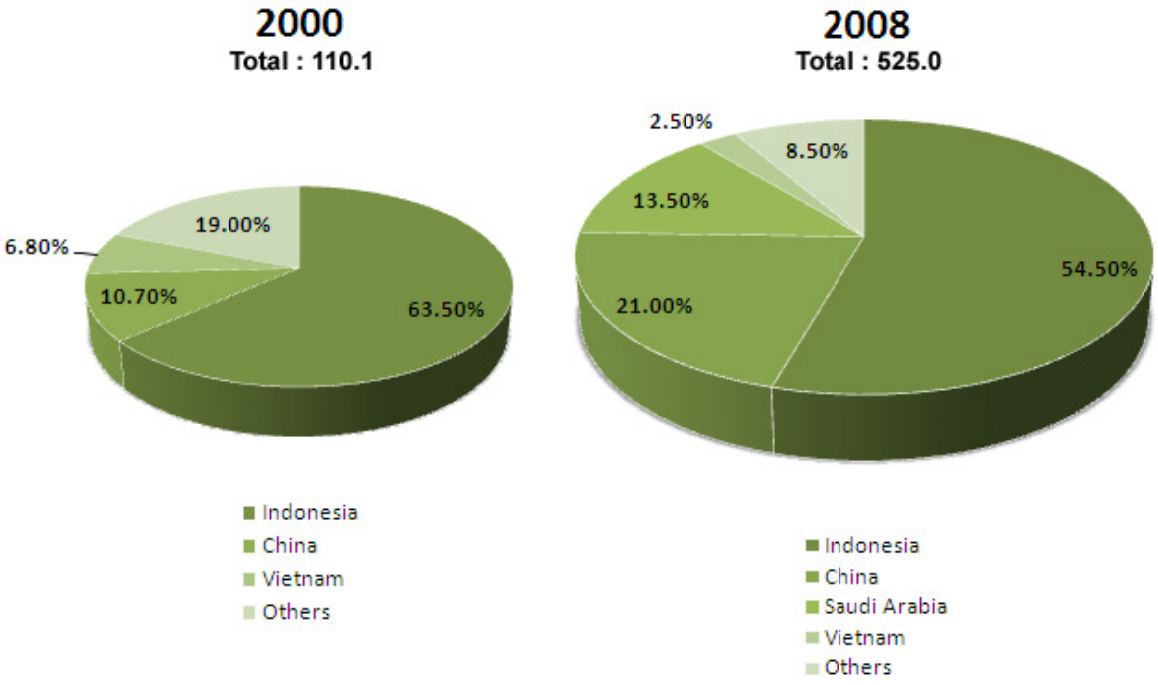
Sources: Department of Statistics; FIAM and industry estimates

Figure 5: Malaysian urea imports (RM '000), 2000-2008



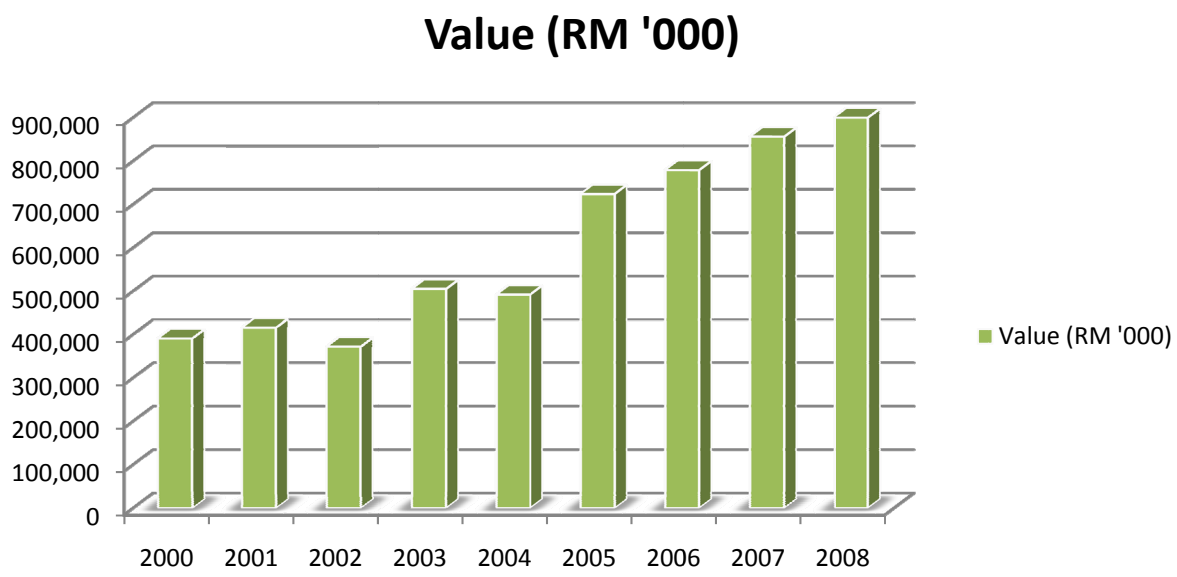
Sources: Department of Statistics; FIAM and industry estimates

Figure 6: Urea import by country (RM million) in 2000 and 2008



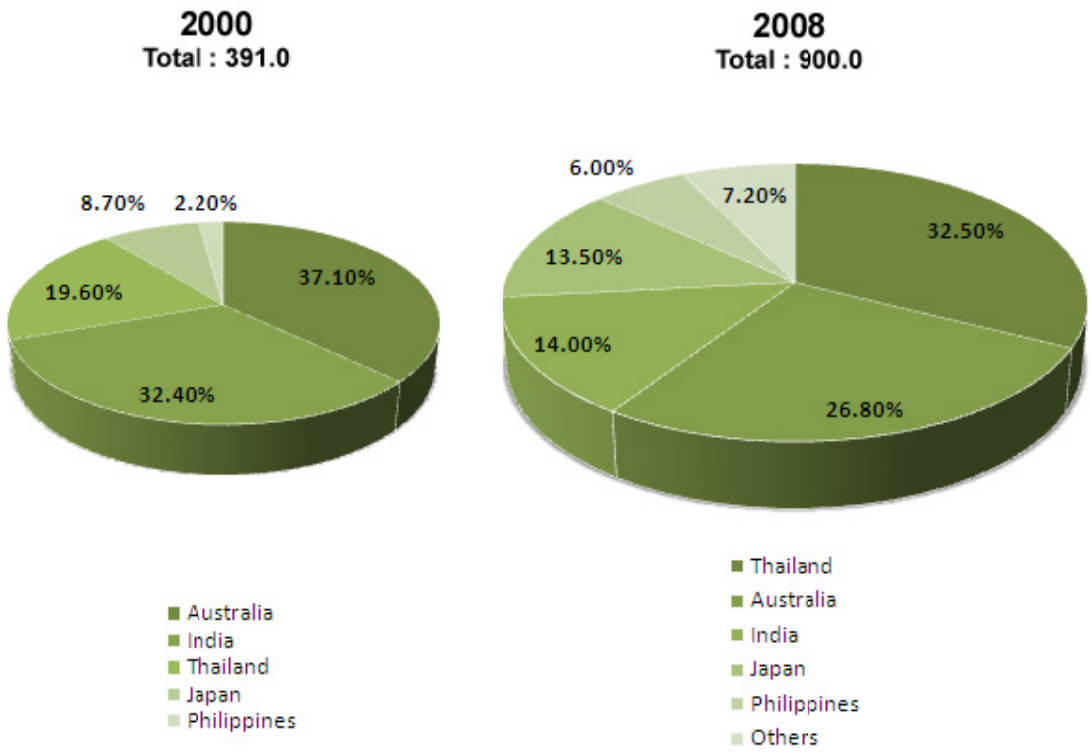
Sources: Department of Statistics; FIAM and industry estimates

Figure 7: Urea export from Malaysia (RM '000), 2000-2008



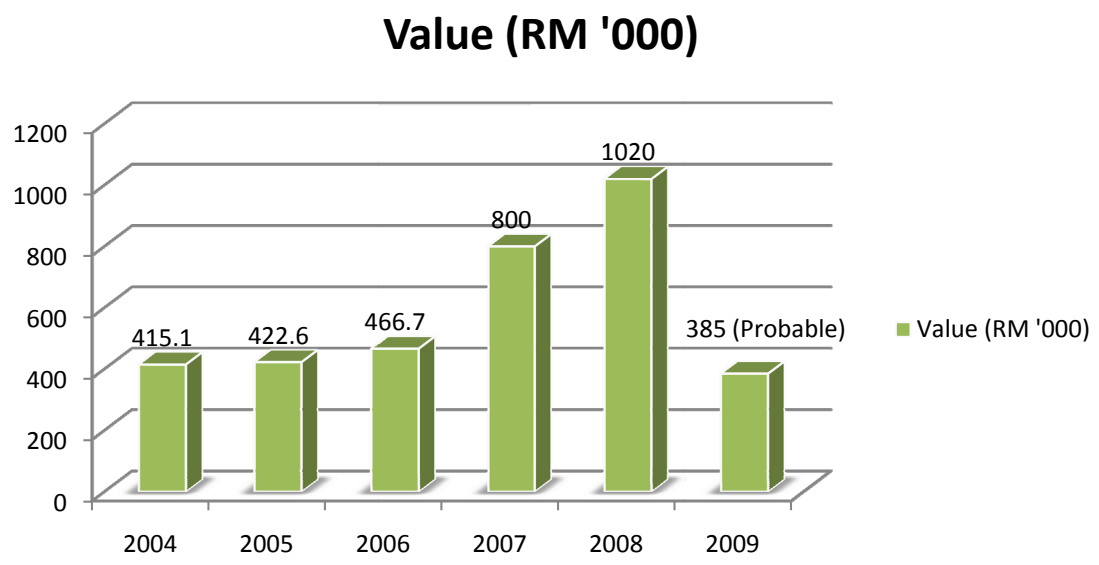
Sources: Department of Statistics; FIAM and industry estimates

Figure 8: Countries importing Malaysian Urea (RM '000)



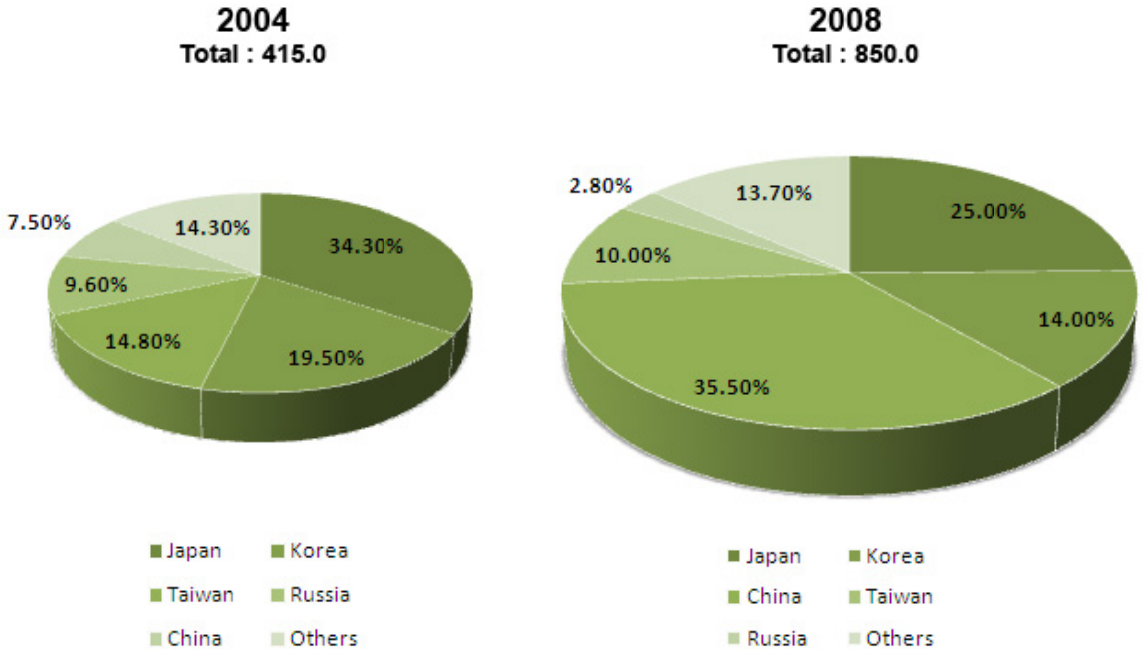
Sources: Department of Statistics; FIAM and industry estimates

Figure 9: Import of Ammonium Sulphate (RM '000), 2004-2009



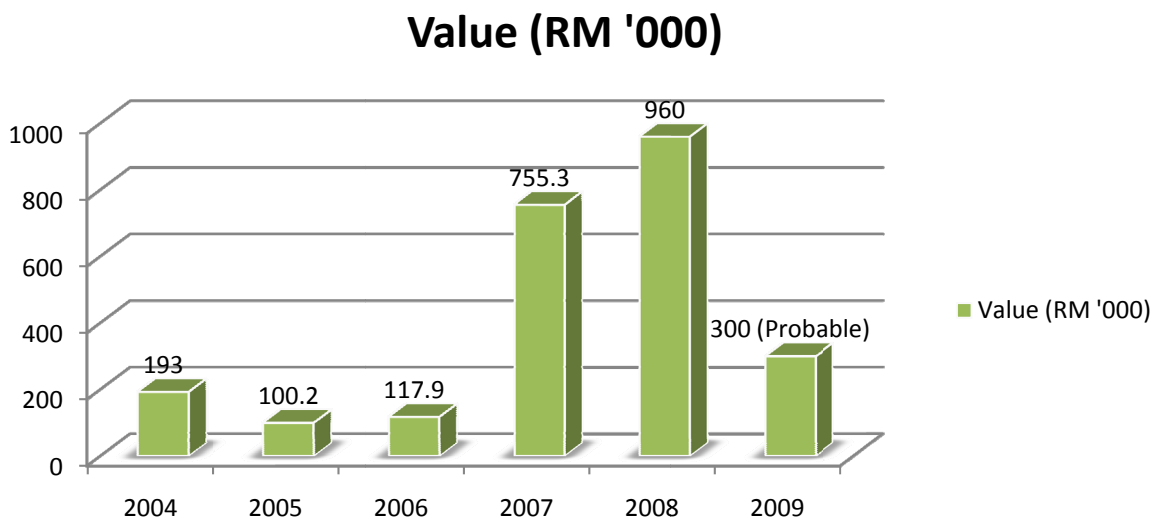
Sources: Department of Statistics; FIAM and industry estimates

Figure 10: Major import sources of Ammonium Sulphate in 2004 and 2008



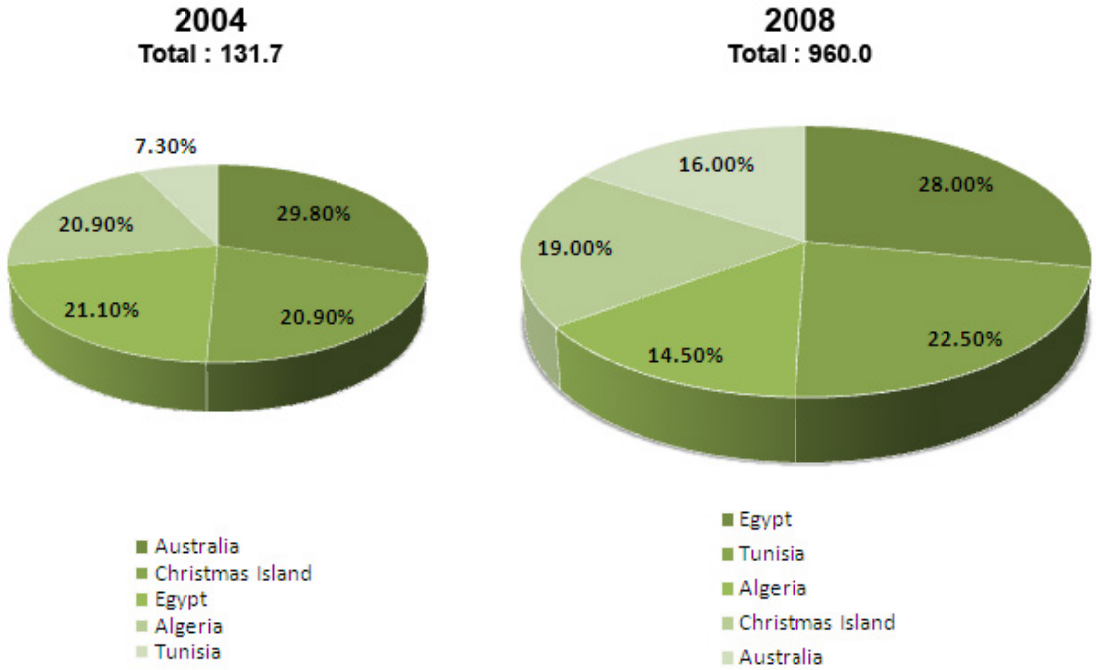
Sources: Department of Statistics; FIAM and industry estimates

Figure 11: Import of Rock Phosphate (RM '000), 2004-2009



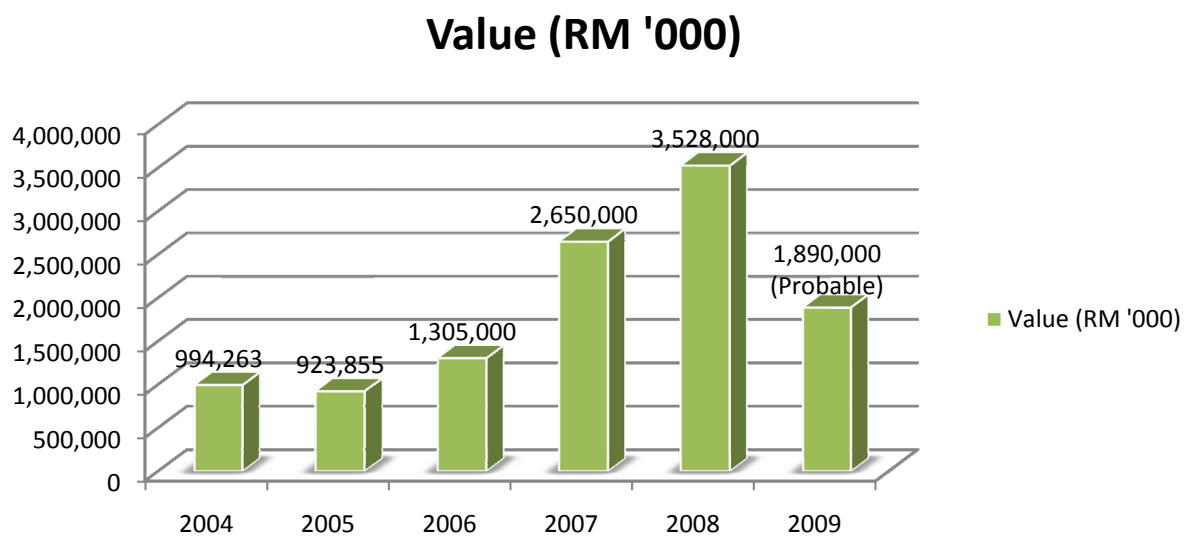
Sources: Department of Statistics; FIAM and industry estimates

Figure 12: Major import sources of Rock Phosphate for Malaysia (RM '000) in 2004 and 2008



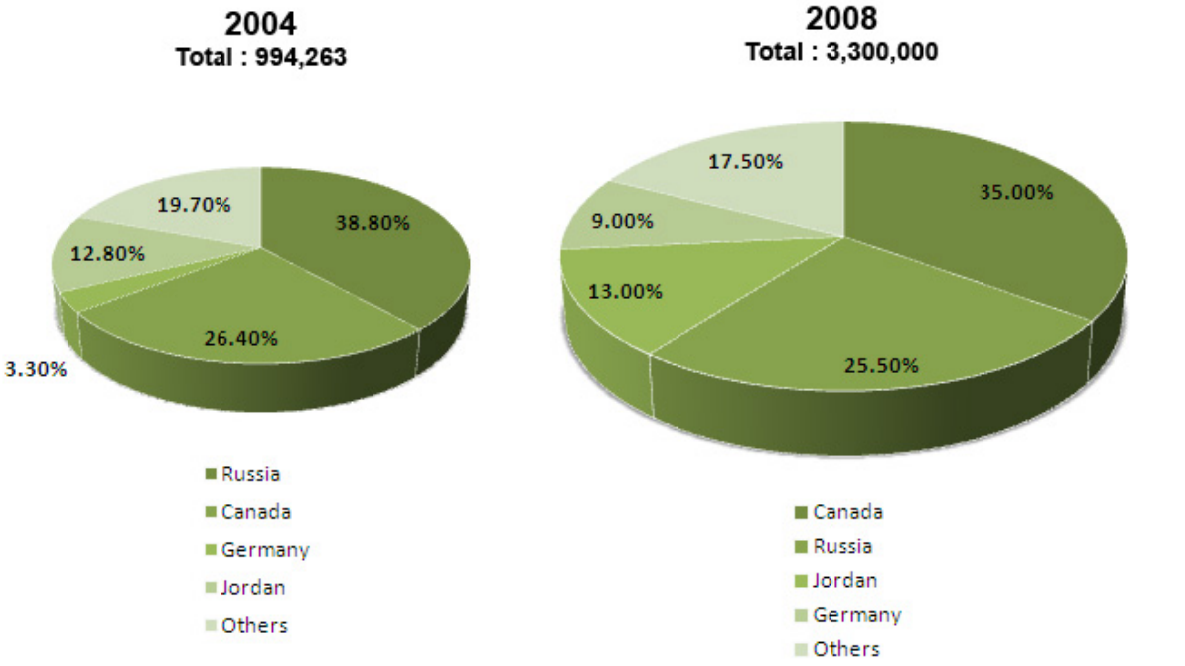
Sources: Department of Statistics; FIAM and industry estimates

Figure 13: Import of Muriate of Potash (RM '000), 2004-2009



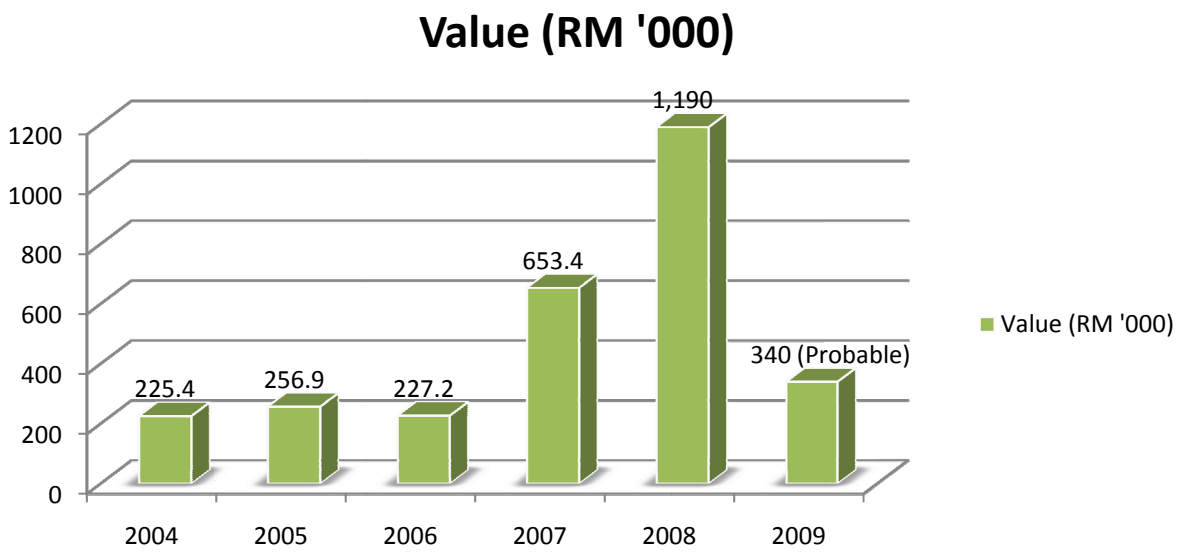
Sources: Department of Statistics; FIAM and industry estimates

Figure 14: Major sources of Muriate of Potash for Malaysia (RM '000), 2004 and 2008



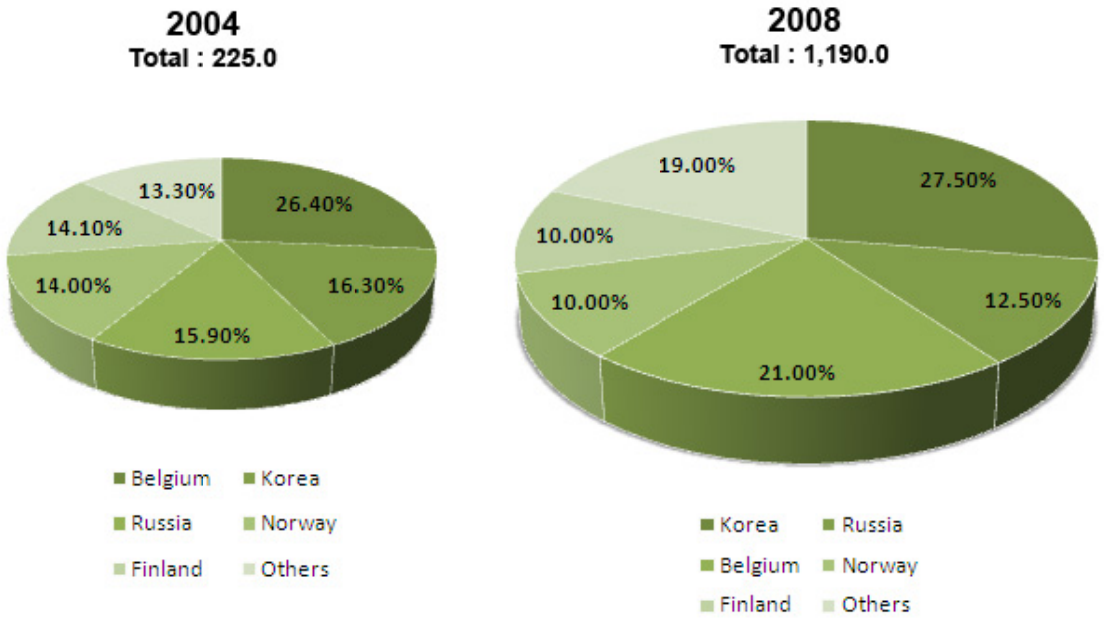
Sources: Department of Statistics; FIAM and industry estimates

Figure 15: Import of NPK compounds (RM '000), 2004-2009



Sources: Department of Statistics; FIAM and industry estimates

Figure 16: Major import sources of NPK compounds for Malaysia (RM '000), 2004 and 2008



Sources: Department of Statistics; FIAM and industry estimates