Vision 2020 – The Palm Oil Phenomenon

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ABSTRACT

Predicting the future performance of an export oriented commodity like palm oil is no easy task. The prediction has to take into account the long run past performance, resource constraints and challenges faced by the commodity at both the domestic and international fronts. This paper attempts to overview the palm oil industry; what it was in the past, its situation today and its likely development in the future.

STERLING PRODUCTION GROWTH

Four decades ago, the production of palm oil was only 1.23 million tonnes compared to 3.43 million tonnes of soyabean oil and 12 million tonnes of animal oil. The production share of palm oil was only 4% against 11% for soyabean oil and 39% of animal oil fats. Today, palm oil is the number two produced oil with a production level of 29.8 million tonnes and a share of 23%. While soyabean oil remains the most produced oil (24%) in 2004, the share of animal fats has declined quite substantially to 18%. Over the years, the global market has become accustomed to the ever increasing availability of palm oil to meet its rising demand (*Table 1*). With production increasing at a sterling rate of 7.87% per annum, palm oil output growth has outpaced the world average of 3.47% per annum (30.8 million tonnes to 129.1 million tonnes over the 40-year period).

The four-decade performance of world palm oil is commendable and it is envisaged that this track record will continue into the future. With continued area expansion and higher yield, world output of palm oil is expected to set a historic milestone in 2015 by overtaking the production of soyabean oil by about 0.26 million tonnes. Palm oil production is expected to reach 37.41 million tonnes compared to 37.15 million tonnes in the case of soyabean oil. Towards 2020, it will continue to be the number one edible oil of the world with a production of 43.3 million tonnes, which is an increase of 50% from the present 29.8 million tonnes. Palm oil will continue to contribute to about one-quarter of world oils and fats supply, 15 years from now (Oil World, 2002). Malaysia, the current number one palm oil producer is forecast to maintain its lead position over the next one and the half decades producing 18 million tonnes or 42% of the world palm oil in 2020. The Malaysian palm oil supply is expected to continue to command about 42% of world palm oil or 9.74% of world oils and fats production in 2020, slightly less compared to 10.5% currently.

AMPLE LAND RESOURCE FOR CONTINUED EXPANSION

There is ample land for another 50% expansion of world palm oil output in the next 15 years. Malaysia, having triggered the phe-

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TABLE 1. PRODUCTION OF OILS AND FATS (million tonnes)

	1962		2004		Annual Growth	2015		2020	
	Million tonnes	% Share	Million tonnes	% Share	% Per annum	Million tonnes	% Share	Million tonnes	% Share
World oils and fats	30.78	-	129.14	-	3.47	165.66	-	184.80	-
Palm oil	1.230	4.00	29.78	23.05	7.87	37.41	22.58	43.30	23.43
Malaysia	0.108	8.80	13.60	45.67	11.79	16.00	42.72*	18.00	41.57*
Indonesia	0.142	11.54	10.02	33.65	10.38	14.90	39.83*	17.00	39.26*
Soyabean oil	3.430	11.14	31.56	24.44	5.42	37.15	22.43	41.10	22.24
Rapeseed oil	1.160	3.80	14.23	11.01	6.14	20.30	12.25	22.70	12.28
Sunflower oil	2.290	7.44	9.81	7.60	3.52	14.72	8.89	17.00	9.20
Animal fats	12.040	39.12	22.82	17.67	1.53	8.56	5.17	9.14	4.95

Note: * As proportion of world palm oil output.
Sources: MPOB (2004); Oil World (various issues).

nomenal commercialization of the commodity from only 54 000 ha in the early 1960s to 3.4 million hectares in 2004, has been the role model to many countries to plant oil palm (*Table 2*). In 1980, the world oil palm area was only 1.8 million hectares and it has increased to nearly 8 million hectares at the end of 2003 through the involvement of Indonesia and to a lesser extent Papua New Guinea, Colombia and Thailand. Currently, Malaysia and Indonesia together have a land share of 6.2 million hectares. In the former, recent land expansion for oil palm planting has been from the opening of new land in Sabah and Sarawak, which altogether contributed to 70% of the growth in the national oil palm area from 1994 and 2004. In the next one and the half decades, Malaysia is expected to continue to expand its investment albeit at a slower pace to fully develop another 0.75 million hectares in these two states. In the next 10 years, the present oil palm hectarage in Malaysia is forecast to increase to 4.3 million hectares and by 2020, Malaysia is expected to have 4.6 million hectares under oil palm (*Table 4*).

Investments in oil palm planting in Indonesia has picked up tremendously in the 1980s and 1990s with the area increasing to 1.13 million hectares in 1995, nearly a five fold increase from 230 000 ha in 1980. To date, some 3.5 million hectares have been developed for oil palm with Riau, Jambi and South Sumatra as well as West Kalimantan and South Sulawesi being the key growth centres (Barlow *et al.*, 2003). Most of the oil palm was developed by Indonesian interest although by 2002, there were over 0.6 million hectares of private estates owned by foreign companies. Some 5.5 million people were directly supported by the industry (Barlow *et al.*, 2003), five times more than those working in the Malaysian palm oil industry. Indonesia has earmarked the availability of some 18 million hectares which are considered potential areas for oil palm (Buana, 2003). Vast land resources, ample supply of labour and increased FDI have been the precursor of expansion and the country has been foreseen to overtake the Malaysian position as the leading palm oil producer.

Market-driven forces have been and will continue to propel investments in these two palm oil producing countries. Being the most productive oil bearing crop with a world average yield of 3.5 t of oil per hectare, producing 5-10 times more oil per hectare compared to other oils and fats, oil palm has been shown to have the highest economic advantage vis-à-vis annuals.

The cost to produce a tonne of palm oil in either Malaysia or Indonesia is cheaper (compared to oils from the annuals in the temperate countries) because of the relatively cheaper factors of production. Indonesia for instance, managed to produce palm oil at USD 165/t and Malaysia at a cost of USD 239/t (LMC, 2001) (*Table 3*). On the other hand, the production cost of the annuals is high in USA as well as in European Union (EU) despite escalating farm assistance. It is two times more expensive for farmers in Europe to produce rapeseed oil (USD 400/t) and it costs USD 459.90 to produce 1 t of soyabean oil in USA. As the world economy liberalises under the aegis of WTO, it is envisaged that the reduction and eventual dismantling of domestic farm support and other trade barriers will gradually eliminate inefficient producers. Whilst that may be so for the developed countries, Brazil and Argentina have done remarkably well to be very competitive producers with cost of production slightly below Malaysia's cost although higher than Indonesia. Nevertheless for palm oil in Malaysia, it is poised to position itself in the next 15 years by leveraging on its inherent advantage through better planting materials and management practices.

CATAPULTING PRODUCTIVITY

Targeting to produce an additional 4.5 million tonnes of palm oil in the next 15 years is a challenging task for Malaysia. This is even more challenging when one takes into account the stagnation of the average oil yield at 3.6 t/ha over the last one decade. This represents yield gap of about 60% as oil palm has the potential of producing 8.8 t oil per hectare (Jalani *et al.*, 2002). A yield improvement of 10%-20% can be expected in the near term with the advent of clonal hybrids and clones with improved oil-to-bunch and adaptability to specific environmental and/or agronomic conditions. Campaigns on productivity and better management practices are ongoing efforts to spearhead improvement in both fresh fruit bunch (FFB) yield and oil extraction rate (OER) in Malaysia. Over the long-term, the industry is set to propel itself towards attaining greater heights with its Vision 35:25 (FFB yield of 35 t/ha/yr with 25% OER) by 2020.

The vision is achievable. The present day planting materials already have the potential to produce 8.8 t oil from 35 t/ha FFB and 25% of OER (Jalani *et al.*, 2002). Dwarfness and long bunch stalk traits are readily available in advanced breeding materials and they appear to be height heritable. High iodine value (I.V.) and high oleic acid are also traits that can be incorporated into oils for cooking and salad oil markets in temperate countries. High oleic oil will additionally be a good chemical feedstock for the production of oleochemicals and biodiesel. Commercial DxP materials giving oils with I.V.'s as low as 60 and close to 70 after double fractionation are in the pipeline. Genetic transformations for high oleic palms are underway and expected to be available in 10-15 years.

TABLE 2. WORLD OIL PALM ('000 ha)

Year	World	Malaysia	Indonesia	Colombia	Ivory Coast	Papua New Guinea
1980	1 756	805	230	27	100	15
1981	1 855	868	248	28	100	18
1982	1 984	950	270	32	102	22
1983	2 135	1 051	297	37	106	25
1984	2 293	1 125	341	40	109	27
1985	2 469	1 212	395	47	108	29
% Change 80-85	40.6	50.6	71.7	74.1	8.0	93.3
1986	2 668	1 293	475	52	107	31
1987	2 538	1 264	416	52	106	31
1988	2 786	1 369	501	57	109	34
1989	3 029	1 483	575	66	114	37
1990	3 271	1 599	605	81	125	37
% Change 86-90	22.6	23.7	27.4	55.8	16.8	19.4
1991	3 561	1 713	715	90	135	42
1992	3 493	1 889	819	106	151	50
1993	4 250	2 001	959	111	158	55
1994	4 513	2 080	1 114	112	162	59
1995	4 683	2 167	1 129	117	161	56
% Change 91-95	31.5	26.5	57.9	30.0	19.3	33.3
1996	4 966	2 278	1 280	118	162	57
1997	5 235	2 354	1 440	120	164	58
1998	5 633	2 544	1 647	121	159	64
1999	5 982	2 695	1 807	128	159	68
2000	6 520	2 945	2 014	134	139	72
% Change 96-00	31.3	29.3	57.3	13.6	-14.2	26.3
2001	6 996	3 053	2 465	138	137	75
2002	7 298	3 109	2 734	147	138	79
2003	7 945	3 320	2 973	153	138	83
2004	8 536	3 410	3 320	160	152	88

Source: Oil World (various issue) and MPOB (2005).

CONTINUED DOMINANCE OF PALM OIL IN WORLD TRADE

Palm oil has consistently been the world's largest traded vegetable oil. Its export rose by a hefty 41-folds from a mere 0.55 million tonnes in 1962 to 23.3 million tonnes in 2004 with market share expanding from 9.2% to an astounding 51%. With the highest growth rate of 9% per annum, the export of palm oil has outpaced the performance of soyabean oil whose share only increased from 12.8% to 19.8% over the same period. Both Malaysia and Indonesia accounted for the lion's share of world palm oil exports, with almost 90% of the total trade in 2004. The market shares of sunflower oil and rapeseed oil have grown only marginally from 4.1% and 0.7% in 1962 to 5.9% and 3.2% respectively in 2004. The share of animal oils and fats plummeted sharply from 43.0% to 1.8% in the same period (*Table 5*).

Most of the trade in soft oils is in the form of oilseeds. Soyabean in particular accounts for nearly 80% of the annual oilseeds trade. It is crushed in the importing countries, in particular China, EU and Japan owing to their high demand for protein meal. Even with the combined average export growth of soyabean oil and oil equivalent of imported soyabeans at around 6% per annum, it is still below the growth performance of palm oil export.

Therefore, besides competing with other vegetable oils to gain market share, palm oil also has to compete with oilseeds which generally experience less restriction by the importing countries. In the future, trade is expected to be further liberalized with more opportunities for increased market access (through reduction of import barriers) for palm oil. Palm oil is envisaged to continue to be the number one oil traded on the world market. In another 10 years from now, the export of palm oil is expected to increase to 26.77 million tonnes, more than double the export of soyabean oil and accounting for 50% of the global edible oils and fats trade. By 2020, world trade in palm oil will amount to 31 million tonnes although this would be a slight decline to 46% of the market. Malaysia is expected to continue to lead the world trade in palm oil with an estimated export volume of 15 million tonnes. Developing economies are expected to account for 80% of the world palm oil imports.

TABLE 3. COSTS OF PRODUCTION (selected oils and fats)

Country	Oil	USD/t
Indonesia	Palm	165.20
Malaysia	Palm	239.40
Colombia	Palm	292.80
PNG	Palm	215.80
USA	Soyabean	459.90
Canada	Rapeseed	249.30
EU	Rapeseed	400.60
China	Soyabean	400.60
Argentina	Soyabean	227.60
Brazil	Soyabean	228.30

Source: LMC (2001).

TABLE 4. HARVESTED AREA (million hectares)

	2004	2015	2020
Oil palm	7.90	10.70	12.10
Malaysia	3.90	4.34	4.60
Indonesia	3.10	3.86	4.50
Soyabean	79.09	87.20	90.00
Rapeseed	27.10	30.79	31.90
Sunflower	21.99	24.94	26.30

Source: Oil World (various issues).

TABLE 5. GROWTH IN TRADE (million tonnes)

	1962		2004		Annual Growth	2015		2020	
	Million tonnes	% Share	Million tonnes	% Share	% Per annum	Million tonnes	% Share	Million tonnes	% Share
World oil & fats	5.94	-	46.01	-	5.00	50.18	-	66.8	-
Palm oil	0.55	9.2	23.27	50.56	9.34	26.77	52.41	30.70	45.96
Soyabean oil	0.76	12.8	9.10	19.77	6.08	11.88	23.26	13.30	19.91
Rapeseed oil	0.39	0.7	1.45	3.20	8.99	3.05	5.97	3.00	5.24
Sunflower oil	0.25	4.1	2.73	5.93	7.22	5.19	10.16	6.20	9.28
Animal fats	2.56	43.0	0.83	1.81	- 2.63	2.03	3.97	2.20	3.29

Source: Oil World (various issues).

BRIDGING THE DEMAND AND SUPPLY GAP

Macroeconomic factors such growth in population and disposable income will continue to affect the demand for food items including palm oil. In the next two decades, world population is expected to grow moderately at 1.1% per annum to 7.54 billion in 2020. The population increases will occur in Asia in particular China, India and Pakistan. Asia is also experiencing income growth is propelling the world economy. Palm oil which had made significant in-roads into these populous and income rising countries will continue its dominant position in these markets. The total consumption of world palm oil is expected to be 43 million tonnes in 2020 (*Table 6*). Although, some major palm oil importing countries such as China and India will continue to pursue self-sufficiency in edible oil supply, it is more likely that they will continue to be dependent on import to meet their edible oil deficits. Palm oil has the potentials to bridge the demand deficits.

The increased usage of palm oil vis-à-vis other oils and fats has set the mark for its future expansion. Its consumption growth is most dynamic at 7.9% per annum over the last 40 years. This implies that palm oil has been the most preferred vegetable oil worldwide. Its consumption has witnessed a sharp increase of 23-fold, up from only 1.2 million tonnes in 1962 to 29 million tonnes in 2004 (*Table 6*). Such a dynamic trend is expected to continue to prevail in the future.

The scenario for soyabean oil is also favourable. Despite being the most consumed oil (31 million tonnes in 2004), its consumption only grew by 5.5% per annum and could only muster a eight-fold increase and only garnered 24% market share in 2004 (compared to 22.4% for palm oil). Nevertheless, the dominance of soyabean oil will be overtaken by palm oil over the next 10 years. In 2015, consumption of palm oil which is estimated at 37.22 million tonnes, is expected to overtake the consumption of soyabean oil (37.07 million tonnes). In 2015 and beyond, palm oil will be the most preferred edible oil of the world, with consumption of 43.2 million tonnes in 2020 compared to 41 million tonnes of soyabean oil.

The consumption prospects for other vegetable oils such as sunflower oil and rapeseed oil are expected to hover around 17 million tonnes and 23 million tonnes respectively in 2020. On the other hand, animal fats which used to be the main source of vegetable oil supply in the past is expected to lose a lot of its market share by 2020. Over the past 40 years, its consumption had declined by 0.86% per annum because of consumer concern over their deleterious health effects.

MILLING TECHNOLOGY

Over the years, Malaysia has improved milling technology for extracting oil from FFB. In the past, palm oil mills were associated with air and water pollution and unfavourable smell. Today, all the 380 mills in the country with capacity to process 79.74 million tonnes per year FFB stringently adhere to the Environmentally Quality Act on BOD discharge. These mills participate in the competency scheme of MPOB to improve their product quality. With the establishment of Oil Palm Technology Centre (OPTEC) at MPOB, more new technologies will be developed. In the future, most of the mills are expected to adopt continuous sterilization to enable them to be fully automated. A minimum number of workers will be required by the mills as most of the operation will be run from the control room.

OPTIMIZING LAND USE

In the past, oil palm planting had been on monoculture basis. Few attempts are made to undertake livestock and crop integration (LCI) for fear of crop damage. In the future, an evolution of an integrated oil palm industry is foreseen to be realized where land under oil palm will be jointly utilized to pro-

TABLE 6. WORLD CONSUMPTION OF OILS AND FATS (million tonnes)

	1962		2004		Annual Growth	2015		2020	
	Million tonnes	% Share	Million tonnes	% Share	% Per annum	Million tonnes	% Share	Million tonnes	% Share
World oils and fats	30.39	-	130.03	-	3.52	165.2	-	184.4	-
Palm oil	1.20	4.0	29.12	22.40	7.88	37.22	22.53	43.2	23.43
Soyabean oil	3.37	11.1	31.45	24.14	5.46	37.07	22.44	41.0	22.23
Rapeseed oil	1.15	3.8	14.65	11.27	6.24	20.26	12.26	22.7	12.31
Sunflower oil	2.17	7.1	9.58	7.37	3.6	14.69	8.89	16.9	9.16
Animal fats	11.99	39.4	8.33	6.40	- 0.86	8.56	5.18	9.13	4.95

Source: Oil World (various issues).

duce protein (livestock) and carbohydrate (crops). Currently, there are already successful programmes in Malaysia to integrate the plantation sector through LCI. Whilst oil palm will continue to be the anchor crop, LCI will provide further opportunity for the industry to practise diversification. In 2020, Malaysia will be expected to generate an additional revenue of RM 5 billion to the industry through successful implementation of LCI (Yusof, 2003).

Crop integration requires wider spacing and this can be done through double avenue planting which has been shown to have no adverse effects on the yield of the oil palm. Inter-crop planting of profitable cash crops in the immature and mature period and the introduction of livestock, especially cattle during the mature period has been proven technically and economically feasible (Yusof and Suboh, 1998) generating additional revenue for the whole life span of oil palm. Crops such as hill paddy, sweet corn, yam, yellow sugar cane, pineapple, melon, bananas and even soyabean have been shown to yield returns to investments ranging from 1.2% to 5%. In the case of mixed farming of cattle in mature oil palm areas, MPOB research has shown that the investments are economically and technically viable prompting 78 estates to venture into animal integration (Rosli, 1998). Apart from using the cattle for weed control, the practice of rotational grazing of cattle using portable electric fences, provides extra revenue from the sale of cattle. All these possibilities suggest that an oil palm plantation can produce not only fat but also protein and carbohydrate including protein for animal feed such as soyabean meal. As a comparison, it is not possible to simultaneously integrate soyabean with animal rearing or other crops on the same land in soyabean growing countries.

WIDENING THE FOOD AND NON-FOOD USES OF PALM OIL

Palm oil is known to be versatile and due to its technically superior properties, it encourages wider use in a range of end-products, both in the food and non-food sectors. In the 1960s and early 1970s, Malaysia has led the world in supplying crude palm oil (CPO). Its fast expanding production had to find markets overseas as there was no way the domestic market could absorb the exponential growth in production. However, in mid 1970s, in line with the industrialisation policy of the government, the country undertook a bold step towards greater value addition by making palm oil products available in various fractions and refined forms to meet the specific needs of the market. As shown in *Figure 1*, the export of CPO fell inversely to the rising export of processed palm oil from mid 1970s.

Currently, the refining sector in Malaysia is well established with 47 refineries and 36 kernel crushers in operation, able to process 16.34 million tonnes of CPO and 4.4 million tonnes of kernels. Ten other refineries with a combined capacity of 3.24 million tonnes and 11 kernel crushers (0.42 million tonnes capacity) are still under planning to cater for expected increase in CPO and kernel in the future. Malaysia also imports CPO from neighbouring countries to be processed for export. The import volume has shown a rising trend from 166 115 t in 2001 to 642 300 t in 2004. At the same time, Malaysia has also allowed exports of CPO since 1999 amounting to about 1.3 million tonnes.

The four main traditional uses of palm oil in food products are for cooking or frying, shortenings, margarines and confectionary fats. Palm oil is popularly used in both solid fat products as well as liquid form as cooking oil sector especially for industrial frying applications. It offers several technical characteristics desirable in food applications, such as resistance to oxidation, which contributes towards a longer shelf-life of end products. Palm oil is ideally suited for use as an ingredient in shortenings and margarines as it has 20%- 22% solid fat content at

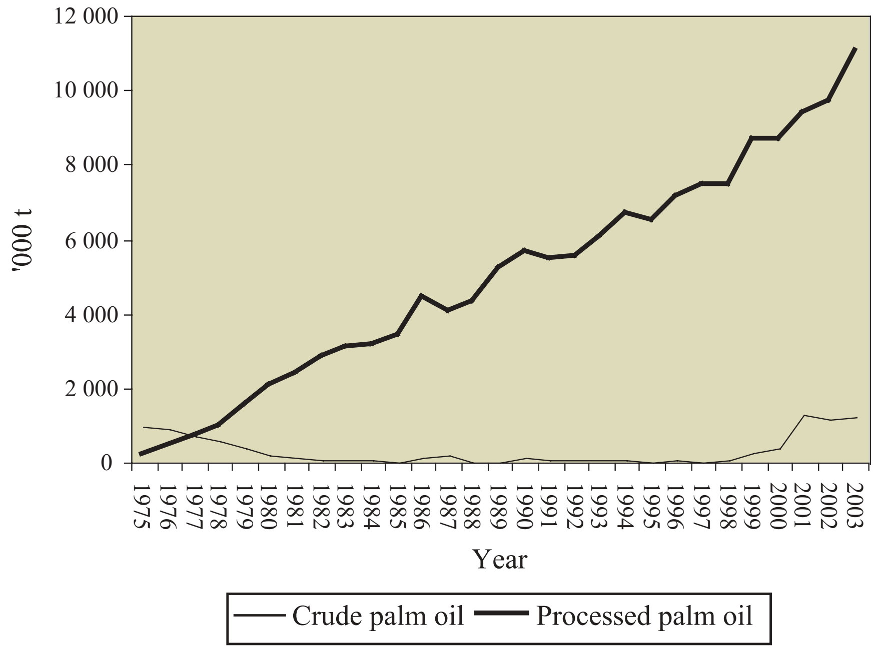

Figure 1. Structure of Malaysian palm oil export.

20ºC, which helps in the formulation of fat products with a variable range of consistency. It tends to crystallize in small beta-prime crystals, a property desirable for some applications, in particular table and industrial margarines. Palm oil also has other functional attributes that make it a valuable ingredient in food formulations. In many applications, palm oil can be combined with harder fractions such as palm stearin to produce products of the required consistency without hydrogenation. Common products made from palm oil and palm kernel oil, wholly or in blends with other oils include frying and cooking oils, shortenings, vegetable ghee or vanaspati, margarines and spreads, confectionary and non-dairy products.

The changing trends in lifestyles and demands for consumer products based on convenience and health considerations have led to other areas of applications for palm oil and its fractions. MPOB has succeeded in formulating products to meet such demands, develop new niches, enter new markets and enhance palm oil's competitiveness. New applications for palm oil in foods include its use in emulsion-based powdered and consumer foods such as pourable margarine, mayonnaise, soupmixes, imitation cheese and microencapsulated palm oil. Exciting products from new processes such as red palm oil or red palm olein have been introduced as healthy cooking and salad oils.

Palm oil as an important source of natural minor components offers a lot of opportunities for the industry to continue to explore new grounds, thus giving it a competitive edge over other oils and fats. The minor components in palm oil, for example, can find their way into nutraceuticals, pharmaceuticals and food supplements. The main ones are carotenoids, vitamin E (tocopherols and tocotrienols), sterols and squalene. At present, only palm-based carotenes and vitamin E are commercially produced in Malaysia. The promising potential for minor components in the health related industries presents opportunities to prospective investors to establish value-added downstream industries to produce and market these products.

OLEOCHEMICALS

The oleochemical industry is another manifestation of the success of the value-added downstream development strategy of the Malaysian palm oil industry. The establishment of the Advanced Oleochemical Technology Centre in MPOB in 1994 accelerated the development of further value addition. By 2020, Malaysia is expected to continue to be the oleochemical hub of the world. Investments in downstream production of high value-added oleochemicals will be further expedited taking into account the advantages over products that hitherto have been produced using petrochemicals. The industry is expected to propel to greater height in view of the continuing demand for eco-friendly products which is expected to increase at the rate of 3% per annum. In 2020, the oleochemicals sector in Malaysia is envisaged to generate export revenue of RM 10 billion from RM 3.4 billion currently earned by this sector.

The phenomenal one and a half-fold increase in revenue will be driven by the overall investment incentives and increased worldwide uptake which are expected to propel the expansion of the industry. The utilization rate, presently at 5% of palm oil and 60% of the palm kernel oil produced is expected to double in 2020. The visionary target is favourable based on the past export track record of 1.8 million tonnes in 2004 from only 0.27 million tonnes in 1992. With a market share of 20%, Malaysia is currently the world largest oleochemical producer.

In the next 15 years, Malaysia will depart from concentrating on the production of basic oleochemicals, *i.e*; fatty acids which are derived from the splitting process, to the production of higher value-added products. These are higher value-added products used in various industries such as textile, cosmetic, pharmaceutical, plastic and other applications. Although fatty alcohols find limited use, their derivatives; fatty sulphates, fatty alcohol ethoxylates and fatty alcohol ether sulphates can be extensively used in the production of washing and cleaning products. Fatty amines are mainly used in the detergent industry as softening agents, in the mining industry as anti-caking agent, as biocides and in road building and other applications. Substitution of the non-renewable and synthetic petrochemical products by these *natural* oleochemicals will be apparent especially in Europe and the Americas. As a result, demand for such products will grow and thus, become the priority areas for Malaysia.

BIOMASS UTILIZATION

It took almost 40 years for the Malaysian palm oil industry to realize its export earnings of RM 30.41 billion in 2004 (MPOB, 2004). Aside from striving for increased revenue from LCI and downstream development in oleochemicals, continued efforts to raise revenue will be made through the spearheading of the utilization of oil palm biomass. Oil palm mimics the *dual purpose forest*, it is a prolific producer of biomass or fibre products which are available regularly throughout the year as raw materials for value-added intermediate and finished products. Oil palm biomass is the answer to growing concern over environmental issues affecting natural forest conservation. The supply of biomass from the oil palm and palm oil processing by-products is seven times the availability of natural timber. Each year, the oil palm industry in Malaysia generates more than 30 million tonnes of biomass in the forms of empty fruit bunches, oil palm trunks and oil palm fronds. Palm biomass such as empty fruit bunches and trunks are being used for commercial products (*e.g.* pulp and paper, medium density fibreboard, automotive components *etc*.). Effective utilization of palm biomass into value-added products has the potential to generate another RM 20 billion in the next 10-15 years.

At MPOB, the Agro Product Unit has made good progress in the biomass conversion technology. Some of the industry players have already developed the capability to produce fibre strands from empty fruit bunches. There are demand for such fibres to be used for mattresses, seats and insulation purposes. Pulp and boardmaking can also be of interest using fibres from oil palm trunks, oil palm fronds and empty fruit bunches. Technologies are available and these include the chemical and semi-mechanical pulping processes. Paper pulp from palm biomass can be used for various end-uses such as writing, newsprint and packaging. Investment in this area is crucially strategic as consumption of paper and paperboard in the country has been rising and almost half of the Malaysian consumption is met by imports.

Export potential for the investment is huge. With a growing demand for high quality and costly pulp in Asia influencing the global supply demand pattern, investment in modern pulp plants and leveraging the availability of local raw materials on a sustainable and environmentally friendly basis will be accelerated.

Another application of oil palm biomass is in the production of composite boards such as plywood, blockboards, particleboards and medium density fibreboard. Some 60 000-70 000 ha of oil palm plantations are replanted annually and this will yield 8-9.5 million oil palm trunks which can be converted to 3-3.5 million cubic metres of sawn timber and 2.7 million cubic metres of plywood. Oil palm plywood has the advantage of being lightweight and environmentally-friendly, thus, being readily acceptable to overseas buyers. The technologies to produce such value-added products are available at MPOB. Four companies have commenced into commercial ventures with success. There has also been commercial production of fibre mat from oil palm biomass. The fibre mat is now used in China to mitigate sand storms.

Oil palm biomass can also be potential feedstock raw materials to chemical and biochemical industry. The cellulose component can be hydrolyzed to yield glucose from which ethanol, citric acid, butanal and other single cell protein can be obtained through chemical and microbiological transformation. Hemicelluloses, also present in the biomass can yield pentoses especially xylose which upon hydrolysis can be converted to xytitol, furfural, furan, resins and furfuryl alcohol. The lignin fraction of oil palm biomass is a potential source of phenolic resins.

THE ENERGY FARM

The biomass generated at the palm oil mills such as empty fruit bunches, fibres and kernel shells can be used to produce electricity to supply the national grid. Technologies are now available to harness the biogas from effluent ponds of the mills for power generation. If the biogas is fully exploited, more of the fibre and kernel shell can be alternatively used for power generation to supply the national grid or for composite fibreboard production. In the future, the carbon credit derived from the use of biogas and biomass for power generation may contribute further revenue to the country. For example, methane (biogas) fetches USD 10/t of tradable carbon under the Kyoto Protocol when it comes into effect in the year 2008.

Oil palm leads many other crops in terms of energy balance. From a total input energy of 19.2 GJ/ha/yr, oil palm gives products with total energy of 182.1 GJ/ha/yr. This high input: output ratio of 9.5 times is commendable as compared to soyabean and rapeseed with 2.5 and 3.0 respectively (*Table 7*). The high energy balance reflects both crop efficiency and reduced reliance on fossil fuels.

Anaerobic digestion of POME produces biogas. It is estimated that about 20 000 m^3 of biogas could be obtained per day from a 60 t FFB hr mill operating for 20 hr. Other solid wastes such as mesocarp fibres and shells are the main sources of energy in the palm oil mills. Most palm oil mills, fairly widespread across the country, are self-sufficient in their energy needs by utilizing on-site palm oil shells and fibres as fuel. Although unit sizes are small (around 1–2 MW), the number is large and significant amount of electricity and steam/heat are derived from biomass.

MPOB research has also shown that palm oil is a good source for liquid fuel. It has been established that CPO can be burnt as fuel in purpose built Elsberg engines. During the 2001 downturn in palm oil prices, it was also shown that CPO can be blended with medium fuel oil to be used as fuel for boilers. Up to 6518 t of CPO was burnt

TABLE 7. INPUT AND OUTPUT ENERGY VALUES FOR OIL PALM PRODUCTS

Farming system	Annual energy value, GJ/ha		
	Input	Output	Ratio
Oil palm (M'sia)	19.2	182.1	9.5
Maize (USA)	30.0	84.5	2.8
Maize (Mexico)	1.0	29.4	30.0
Rice (USA)	65.5	84.1	1.3
Rice (Philippines)	1.0	24.4	4.4
Wheat (India)	6.6	11.2	1.7
Oilseed rape (UK)	23.0	70.0	3.0
Soyabean (USA)	20.0	50.0	2.5
Peas (UK)	0.9	10.3	0.94
Sugar beet (UK)	124.4	82.9	0.7
Lettuce (UK)	5 300.0	10.6	0.002

Source: PORIM (1998).

as fuel in the national utilities power plant at Prai, Pulau Pinang.

The bigger potential is in respect of conversion of palm oil into methyl esters (palm diesel). Road trials involving buses have shown that it can be used as a diesel substitute with positive environmental effects. The palm diesel plant can also produce beta carotenes and vitamin E that can contribute to the viability of the biodiesel project. The other option that MPOB research has unfolded is the possibility of blending processed palm oil with diesel (5%-10%). Malaysia is currently in the process of preparing the regulatory framework to enable the government to mandate the use of biofuel when the situation warrants such an intervention. Diesel is becoming more expensive and its price is rising sharp to USD 70/b in mid 2005 compared to only USD 19/b in 1993 and USD 50/b in 2004. Therefore, more palm oil can be disposed to diesel industry, creating a derived demand for palm oil. With the option of biofuel available to the Malaysian and even Indonesian palm oil industry, there is now a safety net mechanism to defend prices of palm oil from declining to unremunerative levels. The future of the palm oil industry may well hinge simultaneously on the development in the biofuel use/sector. The blended diesel will be known as *Diesel Baru* or the New Diesel. The diesel blend can be trademarked as B2, B5 or B10 depending on the blending composition.

LEVERAGING ON GLOBALISATION AND TRADE LIBERALISATION WAVES

Undoubtedly, agriculture is very much a protected and subsidized sector compared to other sectors. The concerns over inter alia, food security and support for the farming community in both developed and developing countries have led to support and subsidies both in terms of production subsidy, export subsidy and tariff and non-tariff measures to protect their agricultural sector. Hence, it was only in the Uruguay Rounds of multilateral trade negotiations that a serious effort was made to effectively eliminate the adverse trade distorting effects of protectionism and allow comparative advantage and production efficiency to prevail under trade rules that are fair, equitable and enforceable. These concerns continue to be addressed in the new WTO rounds of negotiations, an avenue opened to address the shortcomings of the Uruguay Rounds.

Despite major efforts to improve agricultural trade, farm subsidies are still widespread. For example, Yusof *et al.* (2003) indicated that the US farmers, collectively received an annual average of USD20 billion in direct payments for the period 1998-2002, up from USD 8.8 billion per annum during 1990-1997. The producer support in EU and Japan were also high amounting to Euro 107 billion and JPY 5500 billion respectively in 2002 (OECD, 2005). Besides the farm support, farmers in these countries are also protected through tariff and non- tariff barriers, as well as sanitary and phytosanitary measures.

The world is moving into an era of globalisation and trade liberalisation. Aside from the WTO negotiations, there are several initiatives through Free Trade Areas (FTAs) to foster greater economic co-operation. In the context of oils and fats complex, palm oil is the only oil that is produced on a competitive basis. Hence, Malaysia and other palm oil producing countries will have to leverage on the multilateral trade negotiation and FTA initiatives to seek greater access for palm oil. The future holds bright for palm oil as countries are unlikely to maintain high levels of support for their agriculture. It will be taxing on their financial resources as enhanced by agricultural reform initiated by countries such as the EU often ends up with huge agricultural subsidies.

CONCLUSION

Over the last four decades, palm oil has been the driving force of the world oils and fats economy. Due to economic advantage, investments in oil palm planting has been expanding leading to increases in output which outpaced the average world growth in oils and fats. With practical and attractive choice to importers in terms of price competitiveness and its techno-economic superior attributes for various edible and non-edible applications, its assured all year round supply availability makes it the preferred choice for manufacturers worldwide. In 2015, the production and consumption of palm oil are expected to undertake the position long enjoyed by soyabean oil, to become the number one edible oil of the world. In 2020, world palm oil is envisaged to contribute to about 43 million tonnes of world oils and fats output and continue to serve the needs of a broad cross-section of world consumers, especially in making a contribution to the availability of oils for adequate nutrition in many oils and fats deficient countries.

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