SUSTAINABLE AGRICULTURE SYSTEM IN MALAYSIA[1]

By

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Abstract

The 3rd National Agricultural Policy (1998 – 2010) focuses on agricultural programmes which aim at high productivity while ensuring conservation and utilization of natural resources on a sustainable basis. Introduction of integrated agriculture with main emphasis on agroforestry, mixed farming, rehabilitation of marginal land, recycling of organic waste, mulching, cover cropping, composting, organic farming, and soil and water conservation are some of the measures taken to support sustainable agriculture in Malaysia.

1.0 INTRODUCTION

The Malaysian Agriculture is characterized by two distinct sectors, namely, the plantation sector and the smallholders' sector. Major crops planted are oil palm, rubber, rice, mixed horticulture, coconut and orchard (Table 1). Over-dependence of these primary commodities has made it necessary to use large quantities of chemical fertilizers in order to sustain yield production. The development of primary commodities requires the importation of large quantities of manufactured chemical fertilizers with the annual purchase of 14.5 million tons valued at RM 1.32 billion (Statistic Department, 2001)

However, in recent years, as a result of growing concern on health hazards posed by chemical fertilizers, there is now a concerted effort to review the use of these fertilizers and to place more emphasis on the use of organic fertilizers. These efforts have resulted in the recycling of organic waste and byproducts for productive use, and reduce indiscriminate disposal or burning of waste products which cause both soil, water and air pollution.

In addition to fertilizers, Malaysia is also a net importer of food. By comparative advantage, it is cheaper to import food from neighboring countries than to produce them. The food bill has increased from RM 3.5 billion in 1985 to RM 11.3 billion in 2000 and it is still increasing (Statistic Department, 2001). This has caused tremendous strain on the economy due to lost of foreign exchange, the attendant ill-effect brought about by inflation. The purpose of this paper is to highlight the efforts taken by Malaysia to decrease use of mineral fertilizers and encourage the use of organic fertilizer.

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Table 1 : Areas Cultivated with Commercial Crops in Peninsular Malaysia

Crop	Hectares	% of Total Land Use
Oil Palm	1,858,448	14.05
Rubber	1,854,744	14.02
Rice	425,080	3.21
Cocoa	46,564	0.35
Mixed Horticulture	289,080	2.19
Coconut	189,785	1.43
Orchard	103,261	0.78
Others	8,462,012	63.97

Source : Department of Agriculture, 1995

2.0 THIRD NATIONAL AGRICULTURAL POLICY (NAP3) 1998-2010

The changing needs in the economy in particular acute labour shortage, limited availability of suitable land, increasing cost of production, decline in the exchange rates, the establishment of World Trade Organization (WTO) and the rapid liberalization of agricultural trade have brought new issues and challenges in the agricultural sectors.

In view of the above challenges, the NAP3 was formulated with the overriding objective of maximizing income through the optimal utilization of resources in the sector. The specific objectives of the policy are to enhance food security; to increase productivity and competitiveness of the sector; to deepen linkages with other sectors; to create new sources of growth for the sector; and to conserve and utilize natural resources in a sustainable basis (Ministry of Agriculture, 2000).

This can be implemented through intensification of land use by introducing integrated agriculture with main emphasis in agroforestry, rehabilitation of marginal land and proper soil and water conservation. Efforts will be intensified to improve the fertility of the soil by promoting organic farming and use of organic matter, composting, conservation measures and production of organic fertilizers using the available agricultural waste in the farm.

3.0 AGROFORESTRY

Of late, agroforestry, the integration of forest species into existing agricultural land and animal husbandary has become an increasingly important land use system. Efforts have been taken to establish agroforestry in smallholdings and plantations and the system has been proven feasible technically and viable economically. In view of its attractive benefits, it has been made as one of the strategic action plan of NAP3. One of the objectives of agroforestry in the NAP3 is to encourage the integration of forest trees, rattan, bamboo, and medicinal plants with cultivation of food crops, rubber and oil palm, rearing of livestock and aquaculture on a large scale so as to maximize utilization and returns on the same piece of land.

In recent years, integrated farming has been promoted actively among Malaysian farmers. They incorporate short term crops such as pineapples, chili, maize, livestock rearing especially sheep and poultry, apiculture and mushroom cultivation with perennial crops and forest trees. Normally, this system lasts at the most three years before the canopy closes in. For agroforestry system to be sustainable, correct designs and techniques of planting tree crop, short-term crop and forest trees and choice of forest trees was established. Table 2 shows some tree crop combination in agroforestry system that are considered viable and those still undergoing research.

Table 2 : Some Tree Crop Combination in Agroforestry System That are Considered Viable and Still Undergoing Research

Main Crop	Viable Projects	Undergoing Research
Rubber	Rubber + Cash Crops Rubber + Sheep Rubber + Poultry Rubber + Apiculture Rubber + Mushroom	Rubber + Fruit Trees Rubber + Rattan Rubber + Timber Trees Rubber + Medicinal Plants Rubber + Bamboo
Oil Palm	Oil Palm + Cash Crops Oil Palm + Sheep Oil Palm + Cattle	Oil Palm + Timber Trees Oil Palm + Rattan Oil Palm + Medicinal Plants
Timber Species	Timber Species. + Cash Crop Timber Species + Tobacco Timber Species + Cash crops + Medicinal Plants	Timber Species + Fruit Trees Timber Species + Medicinal Plants Timber Species + Cash Crops + Medicinal Plants Timber Species. + Apiculture Timber Species + Animal Rearing

Source : Abdul Razak et al, 2001; Yakup and Rasip, 2001.

Herbal and medicinal materials with potential for commercial production have been identified in agroforestry system. These include *Eurycoma longifolia* (Tongkat Ali) *Labicia pumila* (Kacip Fatimah), *Andrographis paniculata* (Akar cerita), *Kaempferia galanga* (Cekur), *Cucurma xanthorriza* (Temulawak), *Casia alata* (Gelenggang) and *Morinda cirtrifolia* (Mengkudu).

Among the agroforestry systems that have been developed in this country are direct interrow integration, block planting, perimeter or border planting, and hedge planting system (Abdul Razak, 2001). The choice of timber species is important. They should be fast growing; light branching; deep rooting; self pruning; resistant to drought, diseases and pest; having soil improvement characteristics and has high survival rate under adverse condition. In Malaysia, teak (*Tectona grandis*) and sentang (*Azadirachta excelsa*) have been identified as suitable timber species for commercial production (Abdul Razak et al, 2001; Ab Rasip et al, 2001).

Preliminary financial analysis of hevea agroforestry over 20 years cycle has shown substantial increase in gross income per hectare. The gross income from a heveawood plantation is RM 15,000 while the hevea forestry system provides an income of around RM 159,000.

4.0 MIXED FARMING

In Malaysia, although smallholders' contribution in agriculture sector is significant, they constitute the bulk of low income groups in the country. They suffer the most due to uneconomic land size, price decline in commodities like rubber , cocoa and oil palm, rising production cost and persistent low productivity and income. Since the last 2 decades, steps have been undertaken by Malaysian Rubber Board, Malaysian Palm Oil Board (MPOB), Federal Land Development Authority (FELDA), Farmers Organizations and Department of Agriculture (DOA), Forestry Department and Department of Veterinary Services to maximize the use of rubber, oil palm, cocoa and coconut lands by introducing mixed farming on existing land in an effort to increase land productivity and income of farmers.

In conventional rubber planting, 85% of the exposed areas is drastically reduced to 45% in second year and completely covered at the end of third year (Abdul Ghani and Zulkefly, 2001). The hedge row planting system in rubber has proven to elevate farm productivity and income in sustainable manner both during the immature and productive phase of growing rubber. Beside permitting continuous cultivation of short and medium-term crops, it can simultaneously introduce perennial fruit trees or pastures to support high stocking rates of ruminants or just simply poultry, apiculture or mushroom.

Similarly, in oil palm plantations and smallholdings, several crops have been identified suitable to be integrated in immature oil palm. Work by MPOB in collaboration with smallholders has shown that yellow sugarcane, banana and pineapple in immature oil palm yielded a net profit of RM 11,731.00 from one oil palm crop and 2 ratoons of yellow sugarcane, RM16,644.20 from one oil palm crop and two harvests of banana and RM 3,469.86 per hectare from one oil palm crop and one round harvest of pineapple respectively (Tayeb, 2001). Income improvement of some mixed farming are as in Table 3.

The integration of livestock in crop plantations such as oil palm has benefited farmers especially in saving labour cost up to 50% per hectare per year, reducing weeding cost by 30 – 50%, increase oil palm fresh fruit bunch by 6 – 30% and lower usage of chemical fertilizers and improvement of soil structure through addition of organic matter to the soil (Azizol, 2001, Tayeb, 2001). Among ruminants that have been evaluated on their potential for integration in oil palm are buffalo, cattle, sheep and goat. At present integration of beef cattle in commercial crop plantation has shown to be viable and has now become one of the main livestock development projects carried out by Department of Veterinar Services known as Beef Integration scheme (Azizol, 2001). It is a systematic method of cattle production in plantation area managed scientifically with electric fencing and rotational grazing. The stocking rate for cattle integration is 1 head to 4 hectares. At present, total participation by settlers and smallholders is as shown in Table 4. These farmers have increased their income by RM 160.00 per hectare per year and are less affected by the fluctuation in the price of oil palm and rubber.

Table 3: Income Improvement of Some Mixed Farming

Main Crop	Value Added Components	Period from Establishment (main crop)	Mean Additional Income with Mixed Farming (RM)
Rubber (1.8 ha) Conventional Planted	Vegatable (0.2 ha)+ banana interow	7 years	580/month
Rubber (2.02 ha) Hedge planted	Chili,longbean, groundnut,spinach,sweet potato,maize,banana,bread fruit,coffee, & autocarpus	6.25 years	386/month
Rubber (2.02 ha) Hedge planted	Sugar cane	2 years	1,389/month
Rubber (2.4 ha) Perimeter planted	Cash crop & chicken rearing	4.25 years	1,784/month
Rubber (0.57 ha) Hedge planted	Chili, long bean, cucumber, Water melon & lemon grass	2.5 years	579/month
Rubber (5.2 ha) Conventional planted	Pineapple	2 years	1,958/month
Rubber (1 ha) Conventional planted	Pineapple	3 years	3109/season
Oil palm (1 ha) Hedge planted	Sugar cane - intercrop Banana - intercrop Pineapple - intercrop	22 months 20 months 15 months	533/months 832/months 231/months
Petai (*Pakia speciosa*) or Forest Plantation High Density Planting	Mixed ginger +lemon grass + tumeric	5 years	300/months
Oil Palm (4 ha) Conventional Planting	Cattle	Mature plants	216/months

Source : Abdul Razak, 2001

Table 4 : Participation of Smallholders in Cattle Rearing 2000

State	Participants	Heads (Cattle)
Johor	961	23,674
N. Sembilan	399	6,626
Perak	123	3,961
Kelantan	279	7,039
Terengganu	2	120
Pahang	358	16,193
Total	**2,122**	**57,613**

Source : (Azizol, 2001)

In an effort to increase the income of low income farmers, DOA has also introduced a project integrating sweet corn planting with cattle fattening by feedlot system. In this project, the residues of corn plants are shredded and made into silage to feed the cattle after the cobs have been harvested and sold. One hectare of corn can provide sufficient

raw materials for 12 head cattle in a year. This successful project has increased the income of farmers from RM 200 to RM 1000 per month (Department of Agriculture,1999). Outside the granary areas where only one rice crop is planted a year, the DOA has also introduced another integrated system of farming which includes the planting of short-term crops after the rice crop, chicken and duck rearing and aquaculture. The income of farmers has increased from RM 580 to RM 1000 per month (Department of Agriculture, 2000).

5.0 USE OF ORGANIC WASTE AND ORGANIC FERTILIZERS

Waste from oil palm industry perhaps forms the largest portion of total agricultural waste in Malaysia. Most of the wastes from oil palm plantations such as dead fronds, empty fruit bunches are effectively recycled back into the plantations. Palm oil mill effluence (POME) is being used as organic fertilizers or enriched fertilizers for other crops. The palm kernel is effectively use to produce palm kernel cake for animal feed. The successful treatment and recycling of these waste products which are otherwise hazardous to the environment if disposed of indiscriminately is an encouraging and positive step towards maximizing the use of resources and preserving the environment.

Chicken droppings are the most popularly used organic fertilizers in vegetable and fruit cultivations. Usually, farmers normally use 5 –10 tons of chicken droppings in addition to chemical fertilizers.

In fruit cultivation, 5-10 kg of chicken droppings is applied in the planting holes besides inorganic fertilizers. An additional of 3-4 bags of 20 kg chicken droppings each are normally placed within the canopy areas for established trees. In rehabilitation of marginal land where problem soils such as tin tailings and sandy beach ridge soils exist, application of 20-40 kg of organic matter in the planting holes is a normal practice. Fruit trees like carambola (*Averrhoa carambola L.*), ciku (*Achras zapota L.*) papaya (*Carica papaya L.*)and mango (*Mangifera indica L.)* have been observed to produce yield similar to normal soil. POME and oil palm empty bunches are also used in the planting holes and additional to top dressing applications.

In the replanting of oil palm, zero burning is practiced in plantations where the felled trunks are cut into small pieces. The old method of burning the tree trunks is hazardous to the environment and wasteful due to loss of organic matter. Open burning is currently prohibited in Malaysia. In areas where there is high infestation of Oryctes beetles, pulverization of the chopped stem is done (Hashim Tajudin, 2000).

Zero burning techniques not only provide a clean environment but also add organic matter, improve physical and increase the fertility of the soil thereby reducing the amount of inorganic fertilizer used. This technique also allows replanting process to proceed immediately after felling and shredding so that the length of time the surface soil is exposed is shortened.

6.0 COVER CROPS

Cover crops normally legume plants such as *Calopogonium caeruleum, Pueraria javanica* and *Mucuna bracteata* are frequently planted in most large plantations and smallholdings of oil palm and rubber. This procedure provides additional supplement of nutrient N to the soil. Immediate planting of legumes help to cover the shredded stem of oil palm and prevent the spread of *Oryctes* beetle.

7.0 MULCHING

This procedure is a common practice especially in oil palm plantations and vegetables crops. In oil palm, dead fronds are aligned along the rows of planted palms. The use of empty fruit bunches as mulch is popular. Before, most of empty fruit bunches were burned to produce ash as a substitute for potash. Presently, it is found that empty fruit bunches used as mulch on planted oil palm seedlings can hastened maturity by about 20 months as compared to 30 months in seedlings without empty fruit bunch mulch. The optimum rate of empty fruit bunch as mulching is 25 ton/ha for newly transplanted seedlings (Hashim, 2000).

8.0 COMPOSTING

Efforts have been intensified to improve the overall fertility of the soil by promoting the use of organic matter among small farmers. In rice cultivation, most farmers normally do not incorporate rice straw into the soil as they prefer to burn the stubble and straws. With a ban on open burning to control air pollution alternative and more beneficial methods of waste disposal are introduced.

The DOA has taken the lead role in teaching farmers to make compost from the waste products such as rice straws, rice husks, maize stalks and leaves and even saw dust from saw mills. The compost are normally sold by group farmers under the guidance of DOA. Preliminary studies by DOA have shown that with proper use of compost, the fertilizer requirement for vegetable crops can be reduced to 1/5 of the total nutrient requirement applied in the form of chemical fertilizers.

In 1990, DOA has initiated a program to encourage farmers to collect rice straws for composting. Collection of straws by hand was tedious and inefficient. To overcome the problem, DOA has fabricated a small straw baler which is cheap and easy to use in rice fields. The baler is attached to a tractor and it is efficient. The rate of collecting straws using the baler is 2.47 hour/ha compared to 31.45 hours/ha for manual operation. At present there are about 178 group farmers participated in the program. The total annual output of compost produced was 621 tons with an estimated value of RM300,000 (Department of Agriculture, 2001).

9.0 ORGANIC FARMING

With the growing preference by consumers for organically produced food due to health reasons, the demand for animal waste is expected to increase sharply. Organic farming has a potential in Malaysia. At present, there are several privately owned organic farms. Since chemical fertilizers and pesticides are not used, labour requirement is high in organic farming leading to high cost of production. The organic products especially vegetables fetch a much higher price, normally 3 times the normal vegetable price. Some high-grade enzyme-enriched compost, fermented organic fertilizers are being used. Recycling of nutrients is done by decomposing the unwanted plant materials collected within the farm.

DOA has taken the initiative in the preparation of a draft Malaysian Standards - Guidelines for the Production, Processing, Labeling and Marketing of organically Produced Food'. Currently, the guidelines is under review by Department of Standards Malaysia. The proposed Malaysian Standard is based on FAO/WHO Codex Draft Guidelines for the production, processing, labeling and marketing of organically produced food.

10.0 SOIL AND WATER CONSERVATION

In the context of efficient land use is the element of soil and water conservation. Much need to be done to ensure the prolonged use of the land on a sustainable basis. Of immediate urgency is the need to reduce soil erosion throughout the country in both the agricultural and non- agricultural sectors. To this end, DOA is monitoring soil erosion losses on various soil types on different slope conditions. This exercise has resulted in the production of Erosion Risk Map of Peninsular Malaysia. The map identifies areas with low, moderate, moderately high, high and very high risk of soil erosion. Armed with these maps, planners and implementers alike will be informed on the potential risk of erosion in existing and proposed project sites and the appropriate soil erosion measures be undertaken.

Under management of sloping land, special emphasis and courses are given to farmers especially in highland areas on how to manage such soil. Sloping Land Development Guidelines were established where staggered land clearing is recommended and it is done during dry season to prevent erosion. Only slopes less than 25^{o} are suitable for agriculture. Specific crops are only suitable depending on the slope classes. Clean felling is only done for certain crops. In agroforestry system of planting, selective felling is recommended. Destumping is only done when necessary. Old stumps and tree debris can help to reduce erosion. Soil conservation structures such as drains and waterways are integral part of a farm. Structures such as bench terraces, silt pits, check dams etc are to be constructed to conserve the land and control soil erosion. Other recommendations on sloping land include cover crops, mulching, contour planting, intercropping, high density planting, minimum tillage and crop rotation (Department of Agriculture, 2000).

11.0 LEGISLATIONS

Malaysia has enacted the following legislations related to land use and environment protection :

(i) Land Conservation Act 1960 relates to the conservation of hill land and the protection of soil from erosion.

(ii) Environmental Quality Act 1974 relates to the prevention, abatement, control of pollution and enhancement of the environment and for the purposes connected therewith.

(iii) National Forestry Act, 1984 provides for the administration, management and conservation of forests and forestry development within the states of Malaysia and for related purposes. The Director General of Forestry Department is empowered to classify every permanent reserved forest including Soil Protection forest and Soil Reclaimation Forest.

12.0 CONCLUSION

In the early years of developing the agricultural sector, Malaysia has relied heavily on conventional methods to produce, increase and sustain food production. There was extensive use of chemical fertilizers to supply plant nutrients and chemicals to combat pest and diseases. However, in recent years, as a result of increasing awareness on health and environment issues, systematic programmes have been introduced to optimize the use of resources on a sustainable basis including the recycling of waste products for food production and environment protection. The successful use of agriculture wastes such as rice straws and husks, empty oil palm fruit bunches, saw dust, animal droppings, POME etc and the implementation of good agricultural practices including biological control methods such as IPM are positive steps undertaken to reduce the dependence on chemicals, and to move towards more natural and healthier methods of food production. Integrated and mixed farming is one successful way of optimizing the use of resources for maximizing income.

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