Status And Potential of Urban And Peri-Urban Agriculture In Malaysia

S. ABD RAZAK and M.N. MOHAMAD ROFF

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ABSTRACT

In Malaysia urban and peri-urban agriculture (UPA) play an important role in managing urban open spaces, provide employment and supply cheap food. The expansion and intensification of UPA production has also improved the livelihoods of farmers. Due to limited land space in UPA, maximizing crop production per unit area is an important issue. The use of technologies such as integrated farming, production of food crops under controlled environment and organic farming has been adopted by UPA farmers to increase productivity. Today, the temperate crops which can only be planted in the highlands in the past can now be successfully grown in the lowlands under rain shelter and aeroponic. One major constraints in UPA in Malaysia is marketing of the produce. Some distribution systems need to be developed that guarantee high price of UPA produce.

Keywords: Urban and peri-urban agriculture, integrated farming, controlled environment, organic farming, marketing channel

INTRODUCTION

Malaysia lies near the Equator between latitudes 1 and 7° North and longitudes 100 and 119° East and is divided into Peninsular Malaysia and East Malaysia. Peninsular Malaysia covers an area of 131 598 km^2, while East Malaysia, covers an area of 198 069 km^2. About four-fifth of Malaysia is covered by tropical rain forest. Peat can be found along the middle and southwestern coast of Peninsular Malaysia and the northwestern coast of East Malaysia. Eastern coast of Peninsular Malaysia is covered with sandy and sandy loam soil. Clay and lateritic soils can be found along the northeastern coast and central parts of Peninsular Malaysia, respectively. Peninsular Malaysia comprises 80% lowlands and 20% highlands.

The average daily temperature throughout Malaysia varies between 21 to 34°C. Humidity is quite high around 80% and the rate of evaporation is about 3-4 mm/day. The annual average precipitation is about 2 500 mm. The seasonal variation

in day length is only 2 minutes along the equator and 49 minutes in the northern regions. On average, the day length in Malaysia is about 12.5 hours (Nieuwolt 1982).

Based on 30 years of wet and dry season records, physical constraints, soils and crop parameters, 12 agroclimatic zones of the Peninsula, Sabah and Sarawak have been mapped for suitability for 15 major crops (Anon 1992). There is a broad spectrum of crop grown throughout the country but the predominance of crops in terms of area and production varies from state to state depending on the crops' suitability to local conditions.

Agriculture Policy

The changing needs in the economy due to acute labor shortage, increasing cost of production, establishment of World Trade Organization (WTO) and the liberalization of agricultural trade have brought new issues and challenges in the agricultural sector. In view of the above challenges, the Third National Agriculture Policy was formulated with the objective of maximizing income through the optimal utilization of resources (Ministry of Agriculture 2000). Recently, the Government has allocated US $3.08 billion under the 9th Malaysian Plan (2006-2010) to transform the agriculture sector into a modern, dynamic and competitive sector. The Government aims to increase agricultural production through measures such as new land development, replanting, and land consolidation and rehabilitation. This will 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 are now also geared toward improving the fertility of the soil by promoting organic and integrated farming.

Agriculture Activities

The Malaysian agriculture is characterized by two distinct sectors, namely, the plantation and the smallholders' sectors. For many years, plantation crops, namely, rubber, oil palm, cocoa and coconut dominated the agricultural development programmes and provided much of the foreign exchange. Most of the fertile alluvial coastal plains and the more fertile undulating foothills have been cleared for the cultivation of these plantation crops. Rice, as the staple food crop, is almost entirely confined to the flood plains.

The major food crops are rice, vegetables and fruits, while the minor food crops are sugarcane, tea and coffee. Rice cultivation, accounted for about 0.67 million ha for all seasons in 2001 (Ministry of Agriculture 2003), oil palm, rubber, coconut and durian also occupy large areas in the agricultural cropping systems. In 2001, there were 3.63, 1.57, 0.15 and 0.12 million ha of oil palm, rubber, coconut and durian, respectively. Together with rice, these crops covered almost 97 percent of the total cultivated agricultural land in Malaysia (Department of Agriculture 2003).

In Malaysia the horticultural crops grown are fruit, vegetable and ornamental crops. Tropical fruits are widely grown either in mixed or single fruit orchards. Smallholders cultivate most fruit. However, there are a few private companies that undertake large-scale cultivation of fruits. The popular fruits cultivated commercially

are papaya, banana, pineapple, star fruit, watermelon and citrus. Except for the pineapple, which is grown on peat soil, other fruits are grown on mineral soils.

Smallholders dominate vegetable cultivation. Most of them operate on smallholdings close to urban areas. The vegetables are grown either in the open or under protected structure. There are several farms that operate on larger acreage of 25 ha or more under rain shelters. These farms are found in the southern state of Malaysia, which is closer to the Singapore market.

Temperate vegetable are being cultivated in the Cameron Highlands and the produce is transported daily to Kuala Lumpur. Vegetable production in Cameron Highlands has been expanding since the early 1970's. The land in Cameron Highlands is leased to farmers with a nominal fee of about US$ 117 ac/year for 5-15 years on a special tenure called a Temporary Ownership License (Midmore et al. 1996). Cabbage accounts for about half of the area gazetted for agriculture in Cameron Highlands, followed by tomato, bell pepper, lettuce, shallot, sweet pea and other temperate vegetables. At present there are about 4 000 farms in Cameron Highlands producing vegetables valued at US $15.6 million/year. Vegetables, such as tomato, chili and cabbage are exported to Singapore, with annual earning of US $15 million. Lately, there has been a shift towards floriculture production in the highlands.

Temperate flowers are grown on the highlands, whereas tropical flowers are grown in the lowlands. Flowers are mainly grown under protected structures both in the highlands and lowlands. Landscape trees are now getting popular and efforts are being made to increase the production. The flower industry contributed another US $6 million/year.

Trends Of Urbanization In Malaysia

The trend toward the growth of urban areas in Malaysia is both a cause and effect of recent industrialization. The productivity growth is greater for manufacturing, compared to agriculture; therefore the employment opportunities in manufacturing provide better incentives for the rural population to migrate to urban areas. Hence urban areas, which are centers of industrialization, grow at a faster rate than rural areas. Cities with economic development expand rapidly as reflected in the population growth in 5 major cities in Malaysia (Table 1). Presently, urbanization in Malaysia is around 51%, where Kuala Lumpur the capital of Malaysia has a population of about 1.6 million. Due to higher standards of living in urban areas, combined with improvements in agriculture technology the small agriculture plots in urban areas have been shifted to semi or fully commercial enterprise. The urban growth areas are concentrated in (a) the region around Kuala Lumpur, (b) the region near Ipoh and (c) the Johore area. The northern and eastern region of Peninsular Malaysia is also expected to grow as Malaysia's incomes rise and the urban dwellers seek greater leisure activities. The region of Sabah and Sarawak will continue to be more traditional with investment in infrastructure related to primary production. Traditionally, the Malays work in agriculture or primary production, with the Chinese in commerce and trade and Indian population working in rubber and oil palm

plantations. However, this historic economic feature has change with the move of Malays and Indian populations to urban areas.

Table 1. Population size of 5 largest cities in Malaysia

Year	Kuala Lumpur	Ipoh	Johore Baharu	Kota Kinabalu	Kuching
1970	648 276	247 969	136 229	NA	61 788
1980	919 610	293 849	246 395	108 725	262 085
1991	1 145 300	468 800	441 703	209 175	369 065
2000	1 297 526	574 041	630 603	305 382	423 873

Development Of Urban And Peri-Urban Agriculture

In Malaysia, the expansion of cities has driven a major shift, from rural to urban and peri-urban agriculture. The rise in cost of living and population growth, coupled with changes in lifestyle in the main cities has influenced the urban population to move towards producing their own food. Wide ranges of temperate and tropical vegetables are cultivated including many native and wild plants which are used as vegetables or salads in small gardens, vacant plots, balconies and containers. Some city dwellers besides growing crops they also raise small livestock for their own consumption or sale if there is demand.

In Malaysia, most farmers are engaged in peri-urban agriculture within or on the fringe of cities. Originally, the vegetables were grown in small patches just to supply for a small urban population and also for own consumption. However, as the population increases rapidly, the supply was unable to meet the demand. This has stimulated semi or fully commercial scale agriculture to cater for the high demand in urban areas. Most idle land in the out skirts of town centers were converted into commercial agriculture farms to grow vegetables and other horticultural crops, raise chickens and other livestock and produce milk and eggs. Chinese farmers mainly operated these. Larger farms are concentrated in specialized areas such as in the highlands for producing temperate vegetables and in the southern states of Malaysia where fresh vegetables find ready market in Singapore. Collectively, these thousands of farms scattered all over the country produce fresh vegetables throughout the year. Farms that produce leafy vegetables provide a quick return to the farmer. Even though, leafy vegetables are perishable, post-harvest losses can be reduced significantly since production is located close to the market.

Lately, there is a decline in land for growing vegetable. Many of the vegetable growing areas especially those in the peri-urban areas are converted and utilized for housing, industrial development and building of highways. The spaces under the power cable lines seem to be the only available areas for vegetable growing within the city limits. In the highlands, vegetables are losing out to the more lucrative floriculture industry and tourism related activities.

About 30-40% of the vegetable planted land is rented. The percentage of rented land is more than 50% in lowland and about 20% in the highlands. The rental cost is only about 5-8% of the total cost of production per year. Over the past few years, crop yield has increased. This was mainly due to the improvement of crop

husbandry practices and use of hybrid seed. But the cost of agriculture inputs and resources such as seeds, fertilizers, pesticides, land, labor and transportation also had increased to 5-10%. Depending where the inputs were imported, the price can go up to 20-30%. This has resulted in the decline in the net income of vegetable farmers especially the tomato and cabbage farmers.

AGRICULTURE TECHNOLOGIES PRACTICED IN URBAN AND PERI-URBAN AGRICULTURE

Integrated farming

Integrated farming (IF) is being promoted vigorously in Malaysia in order to support agriculture and to reduce dependence on mineral fertilizers for crop production. The emphasis is on agroforestry and mixed farming. It is expected that IF will increase the farmer's average income from US $55.6 to above US $277.8 per month. The DOA is promoting rice cultivation integrated with vegetables, sweet corn, fruits, fish and duck rearing; intercropping of coconut with fruits and vegetables; intercropping of rubber with banana, groundnut, maize, pineapple and vegetables; maize production integrated with cattle feed lots (Wan Abu Bakar 2003). Integration of sheep in rubber growing smallholdings also contributes additional income, providing organic manure and reducing weeding costs.

Trough hydroponics

Trough hydroponics is a simple method of growing vegetables without soil. It uses water and dissolved nutrients in a plastic trough or container. A trough made of plastic or opaque material which does not absorb heat and not rust can be used as container. Trough hydroponics is recommended for city dwellers as well as farmers. The hydroponic container can be placed on balcony or patio where full sunlight can be received by the plants. It is a simple, low-cost technology, and is suitable for growing vegetables in areas where land is limited. Planting can be done at any time of the year.

Rain shelter and netted structures

In Malaysia, high value vegtables (e.g cabbage, cauliflower, broccoli) are planted under rainshelters while the cultivation of leafy vegetables (e.g Choy Sam, Pak Choy, Chinese kale) are been carried out under netted structure.

Production under rainshelter is more expensive than under netted structure and in the open field, but is economically viable because it enables limitations of the climate to be overcome. In the lowlands the rainshlter provides shade to the crops against effects of excessive solar radiation. The cultivation of chrysanthemum under rain shelter in Cameron Highlands had less than 1 t/ha per year erosion, which is about 80 times smaller than that in open vegetable farms. The results suggest that open vegetable farming in the highlands is not sustainable due to erosion. It appears that cultivation of crops under rain shelter is more sustainable.

Cabbage, cauliflower, broccoli, tomato and shallot grown under rain shelter gave yields 2-4 times more than those in the open field (Table 2) (Illias et al. 1990). In a year 4 or more crops can be grown depending on the types of crops. The cost/ unit of a rain shelter (netting) with size 30 m by 60 m is around US $15 000 while without netting is about US $12 000. Ran shelters are long lasting or permanent structures where only the plastic roof and side netting need to be change every 3-5 years.

Table 2. Comparison between yield of several high value vegetables grown under rain shelter and in the open field (t/ha)

Types of vegetable	**Yield under rain shelter (with netting)**	**Yield under rain shelter (without netting)**	**Yield in the open field**
Cabbage	37.9	36.1	16.1
Cauliflower	10.3	10.8	2.9
Broccoli	3.1	4.1	1.4
Chinese cabbage	33.4	34.7	20.1
Tomato	NA	80.8	42.9
Shallot	NA	9.5	2.8

Netted structure are supposed to exclude insects thus resulting in a decrease in the amount of pesticides used. Yields produce by crops planted under netted structure is higher than crops plant in the open field (Table 3). Other advantages include prevention of direct impact of rain thus enhancing disease control due to reduced wash-off of fungicides, efficient fertiliser use and improved crop cosmetics resulting in a higher price. All these factors contribute to better yields and returns. The cost per hectare of netted structure is about US $16 000.

Table 3. Crop maturity and yield of several leafy vegetables grown under netted structure

Types of vegetable	**Netted structure**		**Open field**	
	Harvesting period (day)	**Yield (t/ha)**	**Harvesting period (day)**	**Yield (t/ha)**
Chinese kale	43	8-12	40	6-8
Pak Choy	30	10-12	25	6-9
Choy Sam	30	15-12	25	8-11

Aeroponic

In Malaysia, Sime Darby which has rich background in plantation has ventured into aeroponic technology. Aeroponic farming is the latest state of the art and technology to grow premium and quality vegetables. The farm is located on a five hectare plot of land with over 2.2 hectares of production area under greenhouse about 50 km south of Kuala Lumpur.

Farming using aeroponic technology can achieve higher productivity per growing area which also translates to better land utilisation. This is an important point to highlight because of the rate of urbanisation at the expense of agricultural land. Increasing population together with reduction in land will inevitably give rise to

a need to increase productivity in order to cope with the demand near urban areas especially in the vicinity of high density population areas.

Other benefits of the aeroponic technology is its low requirement of water to operate i.e. 10% or less compared to conventional hydroponic methods. In addition, faster growing cycle can be achieved (Carruther 1992). For example, lettuces can be grown in one month compared to two months grown using the conventional way. This is attributed to the conducive growing environment provided for the plants. The roots with the optimum temperature are more efficient in absorbing the nutrient. The current product range includes the temperate leafy vegetables such as Butterhead lettuce, Batavia lettuce, Cos Romaine lettuce and sub-tropical leafy vegetables such as Hong Kong Kai Lan, Chinese Choy Sum and Sio Pak Choy. The products are marketed under the brand name SIME FRESH and can be found in many of the leading retail outlets and hypermarkets in the Klang Valley.

Organic farming

Organic farming in Malaysia was incepted by Center for Environment, Technology and Development, Malaysia (CETDEM) in 1986 on a one ha plot in Sungai Buloh. Since then, the organic movement has expanded slowly and to this day covers 131 ha (Ong 2001). Organic farming is largely confined to vegetable growing. Very little fruits are grown organically. The local organic fruits sold are papaya and watermelons. The organic products fetch a much higher price, normally 3 times the normal price.

With the growing preference by urban population for organically produced food due to health reasons, the demand for animal waste is expected to increase sharply. Since chemical fertilizers and pesticides are not used, labor requirement is high in organic farming leading to high cost of production. Traditional farmers use animal dung, urine, ash and other organic materials available without resort to chemical fertilizers. Studies on the yield response of cabbage to Palm Oil Mill Effluent (POME) showed that 60 t/ha of POME gave the best yield of 21 t/ha (Vimala et al. 1998). Several organic fertilizers were evaluated on lettuce grown on peat soils (Vimala et al. 2000). Results obtained showed that poultry manure out yielded the other organic fertilizers in both the 1st crop and the 2nd crop (Table 4).

Table 4. Yield response of lettuce grown on peat to various organic fertilizers

Organic source	**Yield (t/ha)**	
	First crop	**Second crop**
Processed chicken manure	24.5a	12.5ab
Raw chicken manure	22.9a	20.1a
Kusocom (compost)	21.2ab	8.1b
Worm compost (worm cast)	20.1ab	5.2b
Inorganic fertilizer	15.7b	6.5b
Control	9.3c	1.3c

In another study chicken manure and worm compost were evaluated on *Amaranthus* sp. (Vimala et al. 1999; Vimala et al. 2000). Results obtained showed

that chicken manure was more superior organic fertilizer compared to worm compost (Table 5). The second crop of *Amaranthus*, grown without further additions of organic fertilizer, yielded only 50-60 % of the first crop indicating the need for repeated applications of organic fertilizers to sustain yields. The rate of application can however be reduced for succeeding crops on the same plot.

Table 5. Mean yields of bayam with worm compost and chicken manure

Organic source	**Yield (kg/2 m^2)**	
	First crop	**Second crop**
Worm compost	6.3	3.9
Processed chicken manure	12.3	6.4

In a trial, using compost made from combinations of chicken dung, burnt husk, rice hull and sawdust in the ratio of 3:1:2:5, the yield of papaya and watermelon was 50% less when 100% of the compost was used (Table 6) compared to treatments with incorporation of inorganic fertilizer (Syed 2001; Zabedah 2001). The low yields using organic was attributed to the low nutrient content of the compost applied. The total soluble solids of the fruits however, were not affected. In the case of watermelons, despite the low yields, the size of the fruits had no significant difference with treatments that had inorganic fertilizers.

Table 6. Yield of papaya and watermelons on various combinations of compost

Treatment	**Papaya**			**Watermelon**		
	Yield (t/ha)	**Wt /fruit (kg)**	**Total soluble solid (%)**	**Yield (t/ha)**	**Wt /fruit (kg)**	**Total soluble solid (%)**
NPK only	20.5b	6.66	8.1	14.0	430	13.7
Compost only	24.8a	5.89	7.0	6.6	363	14.0
Compost (50%) + Inorganic (50%)	44.6a	6.03	7.2	10.6	428	14.0

Malaysian organic farmers make use of compost and Bokashi to sustain the soil fertility from left overs of their field harvest. However, other agricultural wastes such as sawdust, rice hull and rice straw form the main compost media. About 5 t/ha of compost and 1.5 t/ha of Bokashi are applied onto the vegetable beds one week before planting. Fish meal or bone meal is supplemented thereafter (Aini et al. 1992).

Flea beetles (*Phyllotreta spp*.) form a major pest of crucifies both in the lowlands and highlands of Malaysia. Several trials were conducted using biopesticide to test its efficacy in reducing the population of flea beetle. Results show that, tea tree oil preparation could be used against flea beetles. Planting Choy Sam under row tunnel was also found to reduce the infestation of flea beetle (Sivapragasam and Mohamad Roff 2002).

Studies also showed that by increasing the diversity of plant in a cropping system, infestation of pests and incidences of virus disease were reduced (Mohamad Roff and Ho 1991). By increasing crop diversity, the population of natural enemies

was also found to increase (Chong et al. 2004). Indian Mustard (*Brassicca juncae*) use as a trap crop reduced damage caused by *Hellula undalis* on cabbage. It is suggested that Indian mustard be grown as hedgerows in the cabbage system to dilute the pest population on cabbage (Sivapragasam and Loke 1996).

In Malaysia, the 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. The proposed Malaysian Standard is based on FAO/WHO Codex Draft Guidelines for the production, processing, labeling and marketing of organically produced food. A wide range of crops are being grown organically including leafy and fruit vegetables, bananas, maize and carombola.

At present, there are several new forms of organic farming in Malaysia namely, Nature farming, Cofarms, permaculture, Kyusei nature farms, biodynamic farms and Yoko farms. Though all systems practice some form of organic food production, the systems need to be coordinated to mainstream organic farming as a form of agriculture that maintains the environment through sustainable food production and to ensure sufficient safe and healthy food is produced for the people.

So far there are 27 organic farms initiated by private sector covering an area of 131.5 ha in the country (Table 7). The Department of Agriculture is constantly monitoring on residue levels of food crops grown in these farms as a measure to promote the organic farming concept to other growers.

Table 7. Number of organic farm in Malaysia

State	Number	Hectare
Selangor	4	10.8
Negeri Sembilan	10	90.0
Melaka	2	1.1
Johor	2	4.0
Pahang	6	11.6
Sabah	2	12.0
Sarawak	1	2.0
Total	27	131.5

MARKETING OF AGRICULTURE PRODUCE

Vegetable marketing in Malaysia involves a totally private enterprise from the farm to retail outlets and export. Up to 90% of vegetables produced are marketed through middleman. The overall marketing structure can be classified into 3 main categories, i.e. direct marketing, contract marketing and consignment marketing.
Direct marketing allows farmers to directly sell their produce to the consumers. Contract marketing involves farmers to sell their produce to the middleman who provides credits to them. Consignment marketing is a system where farmers will only be notified of the farm gate prices of the commodity after being sold in the wholesale market.

There are several factors influencing the price of vegetables.

- existing marketing systems
- major festival seasons
- climate
- import quota and
- institutional buyers

Importation of vegetables can also affect the farm gate prices for crops such as cabbage. Many farmers incurred losses due to the increase in cheap imported cabbage. The price of cabbage also depends on the location or different wholesale client. Farm gate prices of vegetables are always fluctuating and never stable. The price margin between the farmer and the middleman was always in the range of 100-200%, between middleman and wholesaler was 100-150%, and 100-200% between retailer and consumer. By the time it reaches the consumers the price would have increased 300-400%. For example when the price of tomato was US $0.25 at farm gate, the retail price was US $1.25. Very often consumers pay double or triple than the farm price.

Farmers normally sell their produce on a consignment basis to a wholesaler or his agent or collectors. Under this system, the farmers are informed of the prices they will receive only 2-3 days after the produce has left the farm gate i.e., after the produce has been sold in the wholesale market. In other words, the producers do not have a say in the pricing decision, which is made at the major wholesale markets in large cities. At these wholesale markets, substantial quantities of vegetables were distributed to other urban centers. These wholesale markets tend to have a marked influence on the prices received by farmers and paid by consumers (Low 1993).

Benefits

The broad diversity of agriculture activities in urban and peri-urban allows year round production and hence provided employment to city dwellers.

Converting open spaces and unused land into farming plots can help clean up these areas and turn them into clean green spaces at no cost to city authorities, resulting in a reduction in municipal costs for landscape maintenance.

Among the benefits of urban and peri-urban agriculture is increased access to food for low-income groups, supporting the minimum nutritional needs of the population and improving diet due to increased fresh vegetable consumption.

CONSTRAINTS RELATED TO URBAN AND PERI-URBAN AGRICULTURE

The major constraints facing urban farmers are access and/or availability of land and water. Specific land problems arise because town by laws and regulations prohibit food production of certain types especially livestock rearing but sometimes crops also. Even in cities where agricultural use of land has been accepted and

formalized, farming is squeezed by the growth of the city boundaries for residential and commercial purposes.

Water shortage is considered as serious problems in some locations. A high priority to urban farmers is clean water supply close to their plots. Irrigation methods commonly used are obtained either from unsafe or expensive sources. These include shallow dugout ponds, access to rivers, gravity and use of small pumps.

Among livestock keepers, disease is a big problem and leads to high death rates of animals. Animal odors are also incompatible with residential neighbors and neighbor conflict is often a serious issue for urban livestock keepers.

Lack of information about market demands, sudden shortages, and prices is also a limiting factor for urban farmers. When the marketing chain is long, farmers become subject to greater price fluctuations.

CONCLUSION

The contribution made by urban and peri-urban agriculture in Malaysia to the local food supply is big. There are diverse array of food crops coming from different peri-urban farming in many cities. Some consumers prefer locally grown food that has been produced with organic or low-chemical input methods. The consumer benefits of peri-urban agriculture are seen to derive from the diversity of fresh vegetables and fruits made available by this source. These products are important for satisfying nutrition needs.

Information about urban and peri-urban agriculture should be provided to municipal officials in order for them to make good policy decisions. The first step is a census of urban farmers, including what they are producing, their motives and the methods being used. Information about environmental impacts and sensitive areas is also important for reducing contamination and improving management of environmental resources.

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