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From Farm to Table Concept: The Profile and Dynamics of Urban Farming on Agrofood Supply Chain in Malaysia

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ABSTRACT

Due to its interdisciplinary nature and complexity, food supply chain management demands specialized study. The conventional food supply chain includes production, processing, retail, distribution, and consumption. Issues related to the food supply chain are perishability, seasonality, long production cycles, variability in quantity and quality, and transportation costs that might disturb the chain. Urban farming is a potential intervention method for planners to support sustainable food production and shorten supply chains. This paper aimed to determine the supply chain of two urban farm concepts in Malaysia: community gardens (CG) and plant factories (PF). This research used quantitative methods, and the primary data were collected through a structured face-to-face interview involving 154 community garden leaders and 15 plant factory producers between September 2021 and July 2022. Most of the community garden products were sold through direct sales (62%), while the plant factory marketing channel comprised of a One-Level channel that involved restaurants (26%), supermarkets (22%), and direct sales (35%). Furthermore, direct sales are preferable marketing channels for CG and PF as the freshness of the product can be maintained. The results delivered evidence of the potential to harness the multi-functionality of urban farming to improve food security and address community engagement. This shorter supply chain is also associated with higher quality products (freshness), healthy eating, and sustainable production.

Keywords: Supply chain; urban farming; community garden; plant factory; food security

INTRODUCTION

Fruits and vegetables are important as they provide people with vitamins, minerals, and fiber. These industries are also important as a source of income for the farmers and create jobs along the supply chain from farms to the retail markets. Malaysia produces more than 1.16 million tons of vegetables, valued at more than RM3.6 (US$0.68) billion in 2022. Malaysia also produced more than 1.83 million tons of fruits, valued at more than RM12.2 (US$2.46) billion in 2022 (Ministry of Agriculture and Food Security of Malaysia, 2022).

Generally, the production of fruits and vegetables is carried out in rural areas. Farmers transport these commodities by lorry and other means of transportation to consumers throughout the country. More than 200,000 people were involved in producing fruits and vegetables in 2022. The supply chain between

production areas and retail consumers involves many actors and activities, including collectors, processors, wholesalers, and retailers. The distance between production areas and consumers is considered far, affecting the agro-food quality, especially the leafy vegetables. Vegetables that are perishable and have short shelf life will deteriorate and are unsuitable for human consumption.

The food supply chain is interdisciplinary, highly complex, and requires expert analysis to be correctly managed. Toth *et al*. (2016) emphasized that the food supply chain includes production, processing, retail, distribution, and consumption. The issues related to the food supply chain are perishability, seasonality, long production cycles, and variability in quantity and quality. Besides, the variability in logistics costs due to fuel price volatility and political interference also cause a problem in the food supply chain (Gold *et al*., 2016). The food supply chain is a complex network comprising of processes, activities, and entities for transferring food from the initial state as raw material to the final state as a dish on the plate. Everything starts with the food manufacturer, which is the farmers. It is here where the raw foods (fruits, vegetables, meat, etc.) are produced before being sent to the processor. The next level is the processor or packager, which transforms the raw food into the consumer's desired final product. Then, the distributors and retailers are the entities that transfer food products from manufacturer and processor to food retailers and companies in the F&B sector, like restaurants and fine dining (hotels), through various distribution channels.

The economies realize the long supply chain's effect on agro-food commodities and aspire to solve these challenges. One innovation to shorten the agro-food supply chain is producing commodities near the markets or urban farming. The application of urban farming is relatively new in Malaysia. The government encourages more agro-food entrepreneurs to do urban farming near the cities. The application of modern agriculture, such as plant factories and community farming, hopefully will increase agro-food production and, simultaneously, reduce postharvest losses during the transportation of commodities from rural areas to the cities.

This study aims to identify the application of urban farming among agro-food entrepreneurs and urban communities in Malaysia. Secondly, it seeks to evaluate the impact of urban agriculture on the supply chain of agro-food commodities in Malaysia. This article is organized into the scenario of the agro-food supply chain in Malaysia, urban farming including a community garden and plant factory in Malaysia. The next section explains the study design and methodology followed by results and discussion. Finally, the last section concludes the research findings and some recommendations are also suggested.

AGRO-FOOD SUPPLY CHAIN IN MALAYSIA

There are thousands of commercial fruit and vegetable farms in Malaysia. The production of fruits and vegetables is carried out in all states in Malaysia. The production of fruits and vegetables is presented in Table 1.

Table 1. Production of fruits and vegetables in Malaysia, 2021

States	Fruits		Vegetables	
	Land area (ha)	Production (ton)	Land Area (ha)	Production (ton)
Johor	51,143	640,850	17,579	260,708
Kedah	9,734	74,150	1,348	13,895
Kelantan	19,761	147,261	4,747	142,136
Melaka	2,862	19,411	787	11,776
Negeri Sembilan	5,572	69,534	1,759	22,999
Pahang	25,680	247,743	18,574	410,662
Perak	11,440	123,215	7,354	134,877
Perlis	1,486	6,671	413	1,980
Pulau Pinang	2,526	23,016	1,019	13,083
Selangor	5,288	36,121	2,578	36,651
Terengganu	7,653	50,368	1,212	16,266

Sabah	20,302	124,914	4,256	44,614
Sarawak	36,816	147,618	5,723	60,973
Labuan	75	341	67	498
Total Malaysia	**200,337**	**1,711,213**	**67,416**	**1,171,118**

Source: Ministry of Agriculture and Food Security of Malaysia, 2022

More than 200,337 hectares of land are cultivated with fruits, and more than 67,416 hectares of land are grown with vegetables in 2022. Sarawak cultivated the largest area for fruits, while Pahang cultivated the largest area for vegetables. These commodities are marketed to all regions in Malaysia, mainly the big cities such as Kuala Lumpur, Penang, and Johor Baharu, with larger populations or consumers.

The supply chain from production areas to retail consumers involves many actors and activities. In general, the process is presented in Figure 1.

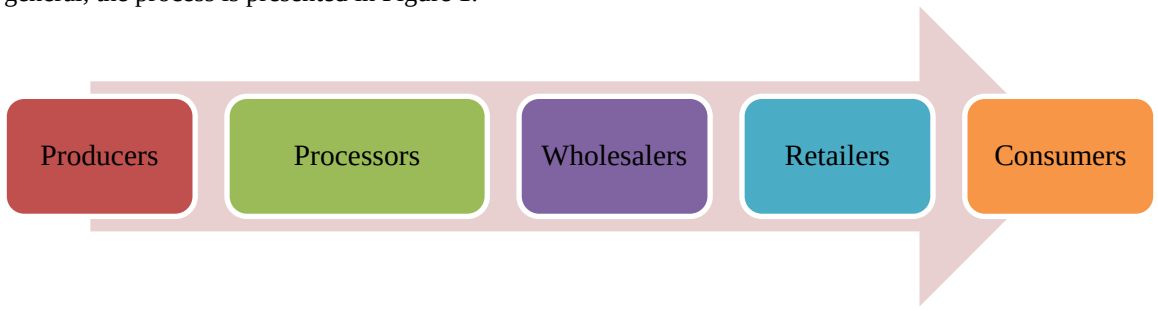

Figure 1. Basic food supply chain system
Source: Toth *et al.*, (2016)

Figure 1 shows that producers or agro-food entrepreneurs cultivate agro-food commodities like fruits and vegetables. The collectors purchase the commodities at the farm and gather all the fruits or vegetables at the processing center. The processor performs grading and selection based on the quality and size of the commodities. The processors sell the commodities to wholesalers. Malaysia generally has two categories of wholesalers: the national level, located in Kuala Lumpur, and the state level, located in states. The National wholesalers sell the commodities to state wholesalers or directly to retailers at the state or district level before the commodities reach the consumers. These activities take time and involve many activities. Due to its perishability and short shelf life, many commodities are damaged during transportation and processing.

A study by Man *et al*. (2009) and the Federal Agriculture Marketing Authority (FAMA) in 2017 revealed that the supply chain of fresh vegetables from growers to farmers involves more than five parties, including collectors, wholesalers, supermarkets, and retailers (Figure 2).

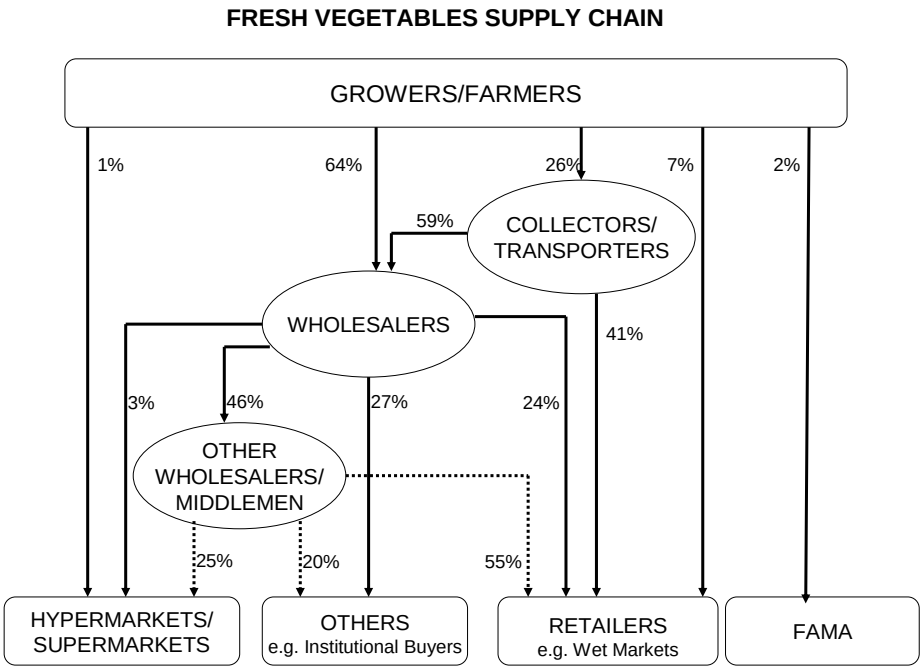

Figure 2. Fresh vegetables supply chain in Malaysia
Note: The percentage in this figure is the share of each channel's total sales.
Source: Man et al., (2009), FAMA (2017).

More than 64% of the commodities are sold to wholesalers, 26% to collectors, and only 7% to retailers. In other words, the wholesalers play the dominant activities in the supply of vegetables in Malaysia. The same study also revealed that the *modus operandi* is like the supply chain of fruits, as presented in Figure 3.

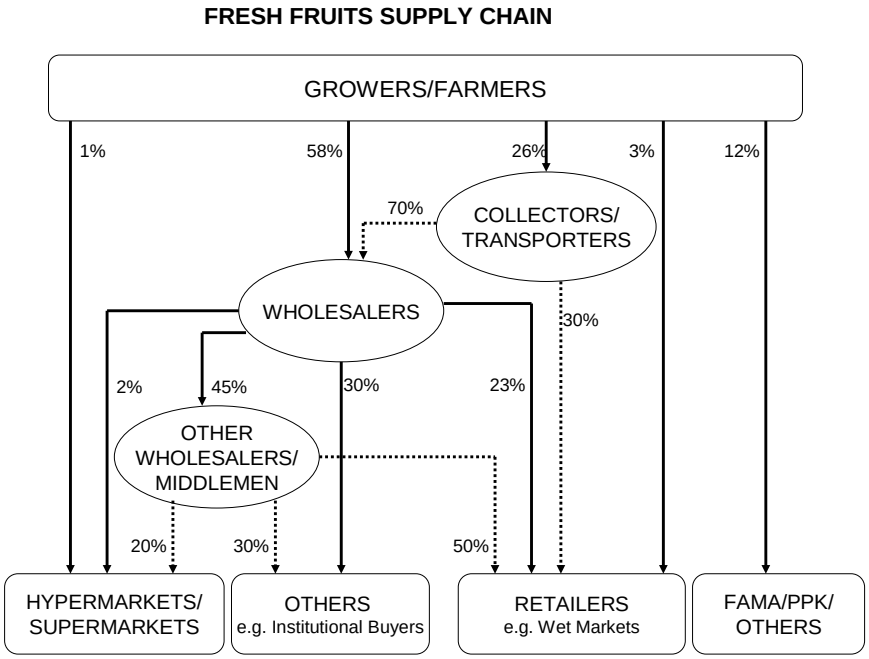

Figure 3. Fresh fruits supply chain in Malaysia
Note: The percentage in this figure is the share of each channel's total sales.
Source: Man *et al*., (2009), FAMA (2017).

Wholesalers dominate more than 58% of the fruit supply chain from growers. The wholesalers distributed the commodities to supermarkets/hypermarkets (2%), other wholesalers, or middlemen (45%) before distributing them to supermarkets at the state level. The wholesalers also sell the commodities to institutional buyers such as cooperative retailers. Farmers sell more fruits through FAMA (12%) than vegetables (2%). FAMA is a government authority that helps farmers market their products. The study shows farmers depend more on FAMA to sell their fruits than vegetables.

Urban farming

The Food and Agriculture Organization of the United Nations (FAO, 2020) defines urban farming (UF) as an agricultural tradition brought to the city, encompassing agricultural production beginning with the cultivation, processing, and intensive distribution of the food, followed by growing crops and livestock in and around the city to prepare fresh food, create jobs, recycle waste, and build the city's resilience to climate change. The FAO divides UF into two categories: Uncontrolled Environment Agriculture (UEA) and Controlled Environment Agriculture (CEA) (Game and Primus, 2015; Armanda *et al*., 2019). UEA includes open-space vegetable gardens, rooftop gardens, and community gardens, widely claimed to play a role in food security in cities or communities worldwide. In contrast, CEA encompasses agricultural practices that apply environmental optimization, usually in conjunction with surrounding urban structures. Examples are greenhouses, indoor farming, and plant factories (Game and Primus, 2015; AlKodmany, 2018).

Plant factory

Innovation, infrastructure improvements, product processing, and distribution leading to globalization are ordinary for food product manufacturers. Global distribution enables the food business to buy products at the best cost, reach new markets, and access fresh products throughout the year. However, this globalization and the constantly increasing world population have made the food supply chain much more complex, putting it under tremendous pressure to fulfill the food demand.

Hence, it is a considerable obstacle in developing an innovative, intelligent, and climate-resistant food supply chain to ensure food safety. Many new business models have been implementing initiatives and circular practices in their food supply chain to minimize wastage and play their part in resolving this obstacle. One of the fruit and vegetable production practices is a plant factory (PF).

A plant factory is an agricultural system created by integrating numerous technologies. With the support of information technology, the modern PF system can be controlled entirely by automation to satisfy the growing needs of various plants with different biological features (Nicholas, 2015; Shamshiri *et al.*, 2018).

PF becomes an approach for smart agriculture and sustainable systems with some features:

- Artificial lighting systems, like LED, increase the plant's growth rate and quality (Watanabe, 2011; Shimizu *et al*., 2011).
- It has a vertical farming system to save space and land usage.
- Landless cultivation uses a hydroponic irrigation system to provide nutrients and water to plants (Hwang, 2012).
- PF operation could be automatized using computers, which indirectly leads to a lower need for a labor force than the conventional agriculture approach (WinterGreen Research, 2010).
- Vegetable production in the PF is protected from the outdoor environment; the total output is increased, consistent, and predictable (Huang, 2019).
- The indoor cultivation system of PF could be isolated and completed from the external environment. Therefore, growers can ensure that the production is disease-free and without pesticides. The crops could be free from pollution caused by pesticide residue, and the food safety benefits are highly appreciated by consumers (Boccaletti dan Nardella, 2000; Cranfield dan Magnusson, 2003; Cranfield *et al*., 2010).

The PF can be developed near housing areas like shophouse, empty buildings, or containers. Thus, being near consumers is made easy. This method will significantly reduce the traditional supply chain's traveling time and distance. Hence, increased customer satisfaction. However, PF has some areas for improvement, especially the extremely high energy usage, leading to increased operational costs. Yet, research is being carried out to reduce the energy residue and increase energy efficiency (Sayuti et al., 2022).

The existence of PF has changed the traditional supply chain from a farm-to-table concept, and it would only be able to meet the demand in the future with any improvement. Of course, the existing food supply chain cannot and should not be replaced entirely, but it can be improved and added with sustainable practices and new models like this PF.

Community garden

A community garden (CG) is a shared, semi-public space where people in the surrounding area work together to cultivate food crops, maintain the garden, and harvest the yield. Every member shared the capital and the yield from the CG. They used the harvested yield or sold it to the public or consumers from the surrounding areas. CG draws numerous benefits, especially food safety, specifically for people from low-income groups, job opportunities, and training for disadvantaged and marginalized communities (Siegner *et al*., 2018). In addition, CG also gives easy fruit and vegetable access to surrounding residents.

A few major cities in the Asian region have conducted CG programs that aim to contribute towards a consistent local vegetable production system (Akaeze and Nandwani, 2020). For example, cities in South Korea, Japan, China, and Singapore have been listed as areas that practice community gardens that focus on food production for self-sufficiency (Giriwati *et al*., 2018). A recent study revealed that five of every six city dwellers' families spend 70% of their earnings on food in India, while in Kuala Lumpur, food accounts for 45-50% of total household expenditure. (Zezza & Tasciotti,2010).

Generally, there are four categories of CG programs identified in Malaysia: (1) individual, (2) community, (3) school, and (4) institution (private and government) (Othman *et al*., 2017). The performance of CG has received widespread attention due to its potential to provide food safety, food diversity, job opportunities, and environmental sustainability. From 2014 to now, there have been at least 124,998 participants in the CG programs, which involve 5,065 sites from across the country. Implementing CG can shorten supply chains and reduce fossil fuel dependence, as it is usually in community areas (Perkins, 2000). Charatsari *et al*. (2018) suggest that short food supply chains are an alternative way to distribute agricultural products that encourage new production and consumption patterns and bring together farmers and consumers.

Sustainable supply chain

The production and distribution of agricultural and horticultural products fall under the purview of food supply chain management. The determinants of the agricultural supply chain have specific characteristics, including seasonality of production, multi-product nature, and transportation, storage, and processing to maintain product quality.

Globalization, climate change, and other factors have disrupted the traditional food supply chain. Now that the pandemic has arrived, workers find unbalancing employment, social isolation, and subsistence challenging. Furthermore, due to constraints in many parts of the world, transportation of food and crops is only feasible domestically during the pandemic. Conflict in the country of production can also influence the supply chain. For instance, the conflict between Russia and Ukraine has increased the price of agricultural input (Shahini *et al*., 2022).

A sustainable food supply chain thus guarantees waste reduction, increased productivity limits, and sustainable intensification. To fulfill human needs for a better future and create a sustainable food supply chain, the FAO defined sustainable agricultural development as a tool for managing and protecting natural resources and the orientation of technological progress (FAO, 2014). This agenda was created to meet the

zero-hunger challenge, advance the environment, and achieve social sustainability by raising living standards.

Figure 4. Types of sustainable farming method
Source: Sridhar *et al.*, (2023)

Sustainable agricultural development can be implemented using various techniques, including fully organic farming or other guiding principles. Figure 4 lists some of the main sustainable farming techniques. These agricultural techniques reduce ecological risks while increasing agriculture production and biodiversity conservation. Sustainable agriculture techniques, including urban farming, can be practiced to maintain food security. Urban areas use community gardens, rooftops, backyards, greenhouses, and indoor hydroponic farms as innovative and sustainable growing techniques. According to reports (Weidner *et al*., 2019), urban farming enhanced sustainability by integrating with construction and household garbage.

Farming activities in UF have been recognized in Malaysia as an efficient approach to food security and have recently been expanded (FAO, 2020). Therefore, research related to the supply chain for UF is crucial as it provides details to meet consumer and producer (farmer) satisfaction and demand, thus ensuring food safety (Zecca and Rastorgueva, 2014). Therefore, this study aims to highlight the impact of UF practiced in Malaysia, particularly in community gardens and plant factories, in shortening the food supply chain and addressing the food security issues in Malaysia.

MATERIALS AND METHODS

Study design and data collection

This research used quantitative methods, and the primary data were collected through a structured face-to-face interview involving 154 CG leaders and 15 PF producers between September 2021 and July 2022. The researchers chose the location suggested by the Department of Agriculture, Malaysia (DOA). The number of

CG samples is based on the overall population of CG registered with the DOA using purposive sampling. On the other hand, snowball sampling was applied because of the limited information on PF in Malaysia. More information is needed on the number of entrepreneurs involved in PF. The snowballing approach is used when finding respondents who fit the target criteria is challenging. According to this approach, the current respondents will propose new participants among their contacts, and the sampling process continues until no more participant is identified or the data has saturated (Naderifar *et al*., 2017).

Data analysis

The descriptive analysis method was performed for initial analysis to understand the data and determine the marketing channels of CG and PF products. The data analysis was performed using Statistical Package for Social Science (SPSS) Version 23 software.

Ethical consideration

At the session's outset, the interviewees knew all information acquired was private and confidential. The questionnaire further indicated that any information provided by respondents is subject to research use solely, which the respondents were also aware of.

RESULTS AND DISCUSSION

Plant factory supply chain

The development of the PF industry in Malaysia is centered in city areas like Klang Valley (Selangor and Kuala Lumpur areas). The development of PF in urban areas is because people are exposed to high technology and ready to invest in IT-based business ventures. The business is also targeted to consumers more capable and concerned with quality and food safety, specifically regarding vegetable pesticide usage. Fifteen producers were interviewed based on the list of companies involved in PF. Based on Table 2, most of the PF is carried out in a specific building (33%; *n*=5), followed by a shop lot (27%, *n*=4). The primary commodities PF produces are salad, like lettuce and green coral. Also, the market price for green coral and curly kale is almost the same in each PF, ranging from (RM2.25 (US$0.50)/100g to RM2.50 (US$0.55)/100g) to (RM8.00 (US$1.80) /100g to RM9.00 (US$2.00)/100g), respectively.

Table 2. The information of PF involves in this study

No.	Type of PF	Area (Max. capacity)	Main production	Price
1.	Shop lot	1,200 sqft (=111.5 m^2) (11,800 pot)	Curly kale (280 kg/month)	RM8.00 (US$1.80) /100gram
2.	Housing area	900 sqft (=83.6 m^2) (500 trays)	Microgreens (500 trays/month)	RM15.00 (US$3.30) /tray
3.	Building	1,400 sqft (=130.1 m^2) (7,200 pot)	Lettuce	RM3.00 (US$0.65) /100gram
4.	Container	1,450 sqft (=134.7 m^2) (2,000kg)	Curly kale (1080 kg/month)	RM9.00 (US$2.00) /100gram
5.	Building		Lettuce (600 kg/month)	RM3.30 (US$0.75) /100gram
6.	Building	1,000 sqft (=92.9 m^2) (1,000 trays)	Microgreens (600 trays/month)	RM35 (US$7.80) /tray
7.	Shop lot		Mixed Vege	RM7.20 (US$1.60) /80gram
8.	Kiosk	1,400 sqft (=130.1 m^2)	Green Coral (1000 kg/month)	RM2.50 (US$0.55) /100 gram

9.	Building	50,000 sqft (=464.5 m^2)	Green Coral (4000 kg/month)	RM2.25 (US$0.50)/100 gram
10.	Building	200 sqft (=18.6 m^2) (200 kg)	Herbs (Rosemary/thyme) (2.4 kg/month)	RM12.50 (US$2.80) /100gram
11.	Shop lot	(72 pot)	Lettuce (72 crops/month)	RM5.00 (US$1.10) /lettuce
12.	Housing area	396 sqft (=36.8 m^2) (3,000 pot)	Sawi Sarawak (40 kg/month)	RM9.00 (US$2.00) /kg
13..	Container	400 sqft (=37.2 m^2) (3,600 pot)		
14.	Shop lot	1,540 sqft (=143.1 m^2)	Lettuce (40 kg/month)	
15.	Housing area	200 sqft (=18.6 m^2)	Lettuce (50 kg/month)	RM13.00 (US$2.90)/box

Source: Survey data(2022)

Marketing system of plant factory

The marketing system and PF supply chain are still new in Malaysia. The cost of production through PF cultivation is higher than conventional, with a utility cost (electricity and water) of 30% to 50% of the total cost of production. Hence, the entrepreneurs focus their markets by targeting premium markets, such as hotels, unique restaurants (fine dining/steak house), premium supermarkets (Village Grocer, Bangsar Shopping Center), and direct selling. Marketing strategies through online social media platforms such as Facebook, Instagram, and websites are more effective for promoting PF marketing.

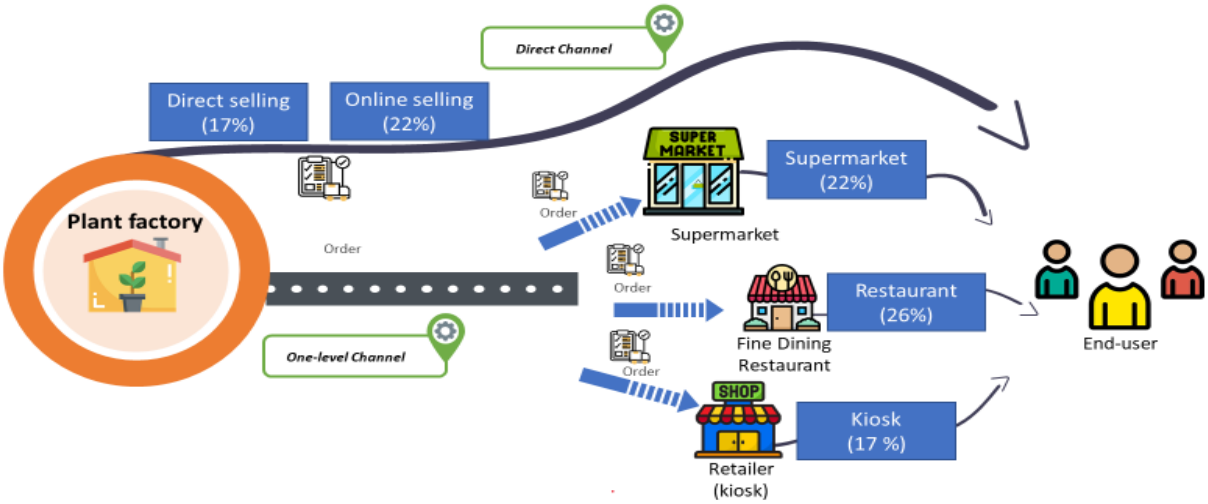

Figure 5. Plant factory supply chain in Malaysia

Figure 5 shows the PF marketing channel comprising one- level and a direct or zero channel. Zero channel is a channel from manufacturers straight to the final consumers. Furthermore, some producers use a marketing strategy through pre-orders by the customers. Entrepreneurs also offered regular delivery packages, such as once weekly or once per two weeks (twice a month). Registered users will be paying for the package either monthly or annually. One-level marketing involves manufacturers to retailers. While the zero channel or direct channel refers to a direct route that allows the manufacturer to sell products directly straight to final consumers. No wholesalers are involved in the sales of crop factory vegetables.

PF is an emerging agricultural industry in Malaysia that has been flourishing since 2021, during the post-pandemic era, with an increase in demand for healthy with no pesticide products. However, a study on the suitable business model is essential before setting up a PF to sustain the business. Setting up a business model for PF involves the products, packaging, labeling, and marketing, including marketing channels. Kozai *et al*. (2022) suggested five business models: 1) producer as retailer, 2) producer as wholesaler, 3) specialty crop producer, 4) social enterprise and farming as a service provider. All business models have advantages and disadvantages. This study shows that all models are applied in Malaysia as presented in Table 3.

Table 3. Business models for plant factory in Malaysia

Business model	Advantages	Business model applied in Malaysia
Producer as retailer	Premium product (high-value). Customers are suited to PF. The place is near point-of-consumption.	*27%*
Producer as wholesaler	Economies of scale. Able to incorporate automation. It improves shelf life and attractiveness to investors. The place is near point-of-distribution.	*27%*
Specialty crop	Premium value crops. Able to grow rare and heirloom plants that are difficult to source.	*13%*
Social enterprise	Social, educational, and welfare aspects of providing fresh green food in often deprived urban communities.	*13%*
Farming-as-a service	Modular systems can be placed at point-of-purchase. Consumers get experience from visiting the PF. Can create and build brand awareness. Reduces distribution costs. The size can be adjusted according to the demands of the retailer.	*20%*

Source: Adopted from Kozai et al., (2022)

Table 3 shows that the two most common business models applied by PF entrepreneurs in Malaysia are producer as retailer and producer as wholesaler. These models enable the producers to sell the products directly to consumers and shorten the supply chain. Farming as a service is also a popular model that allows consumers to purchase the product directly from the PF. Therefore, based on PF's marketing channel in Malaysia, the business-to-consumer is more beneficial than the business-to-business model (Fang, 2016).

Community garden supply chain

Socio-demographic profile of respondents

The data analysis was conducted on 154 respondents (CG leaders), of which 79.2% are men and 20.8% are women. About 56.2% of the respondents are between 41 and 60 years old. Most respondents (87.7%) are Malay and Chinese (3.9%); the rest are Bumiputera Sabah and Sarawak. The findings show that most respondents received tertiary education (46.8%). Besides that, around 43.5% received secondary school education. Approximately 26.6% of the respondents work in the government sector, 29.2% are pensioners and housewives (29.2%). More than half (56.8%) of the respondents received monthly income between

RM2,001.00 (US$422.90) and RM4,000.00 (US$845.80). There were also respondents with a monthly income of less than RM2,000.00 (US$422.90), about 24%, whereas the rest earned more than RM4,000.00 (US$888.80) monthly. Most respondents (48.7%) have between 4 and 6 household members. The findings also showed that most respondents (30.1%) work about two hours in their garden (Table 4).

Table 4. Socio-demographic of respondents

	Category	Percentage (%)
Gender	1 = Man	79.2
	2 = Woman	20.8
Age	1 = 21 to 40	25.5
	2 = 41 to 60	56.2
	3 = 61 to 80	17.6
	4 = 81 and above	0.7
Ethnic	1 = Malay	87.7
	2 = Chinese	3.9
	3 = Others	8.4
Education background	1 = Primary school	5.8
	2 = Secondary school	43.5
	3 = College/university	46.8
	4 Others	3.9
Employment	1= Government Staff	26.6
	2= Private company staff	14.9
	3 =Entrepreneur/Retailing	17.5
	4= Farmer/grower	11.7
	5 = Others	29.2
Monthly income	1= < RM2,000.00 (US$422.9)	24.0
	2 = RM2,001.00 to RM4,000.00 (US$422.9 to US$845.8)	56.8
	3 = RM4,001.00 to RM6,000.00 (US$846.0 to US$1,268.6)	18.4
	4 = RM 6,001.00 to RM 8,000.00 (US$1,268.8 to US$1,691.5)	0.8
Number of households	1 = 0	1.9
	2 = 1 to 3	27.9
	3 = 4 to 6	48.7
	4 = 7 to 9	20.1
	5 = 10 and above	1.3
Garden visiting frequency (hours)	1= Less than 1 hour	3.4
	2= 1 hour	22.6
	3= 2 hours	30.1
	4 = 3 hours	15.1
	5 = 4 hours	15.8
	6 = 5 hours and above	13.0

Source: Survey Data (2022)

Table 5 shows the distribution of community gardens in this study, with the highest number of CG in Selangor (13.6%).

Table 5. The sampling of CG in this study

No.	State	Sample size, *n*	Percentage (%)
1	Johor	15	9.7
2	Kedah	10	6.5
3	Kelantan	9	5.8

4	Melaka	10	6.5
5	Negeri Sembilan	8	5.2
6	Pahang	10	6.5
7	Penang	12	7.8
8	Perak	15	9.7
9	Perlis	5	3.2
10	Sabah	8	5.2
11	Sarawak	1	0.6
12	Selangor	21	13.6
13	Terengganu	11	7.1
14	WP Kuala Lumpur	9	5.8
15	WP Labuan	6	3.9
16	WP Putrajaya	4	2.6
	Total	**154**	

Source: Survey Data (2022)

Table 6. Information on Community Gardens

	Category	**Percentage (%)**
Year of establishment	1 = Year 2020	48.1
	2 = Before year 2020	51.9
Initial investment	1 = RM0	18.8
	2 = <RM2,000.00(US$422.90)	39.6
	3 = RM2,000.00 to 4,000.00 (US$422.90 to US$845.90)	8.4
	4 = RM 4,001.00 to 6,000.00 (US$846.15 to (US$1268.90)	8.4
	5= > RM 6,000.00 (US$1268.90)	24.7
Input cost	1 = RM0	20.8
	2 = < RM 500.00(US$105.70)	63.6
	3 = RM 500.00 to RM 1000.00 (US$105.70 to US$211.50)	7.1
	4 = RM 1,001.00 to RM 1,500.00 (US$ 211.70 to US$317.20)	1.3
	5 = RM 1,501.00 to RM 2,000.00 (US$317.44 to US$423.00)	5.2
	6 = > RM 2,000.00 (US$423.00)	1.9
Operation cost	1 = RM 0	22.7
	2 = < RM 500.00(US$105.70)	68.2
	3 = RM 500.00 to RM 1,000.00 (US$105.70 to US$211.50)	4.5
	4 = RM1,001.00 to RM 1,500.00 (US$ 211.70 to US$317.20)	3.2
	5 = RM 1,501.00 to RM 2,000.00 (US$317.44 to US$423.00)	0.6
	6 = > RM2,000.00 (US$423.00)	0.6
Sales revenue	1 = < RM1,000.00(US$211.50)	70.5
	2 = RM1,000.00 to RM 2,000.00 (US$211.50 to US$423.00)	12.5
	3 = RM 2,001.00 to RM 3,000.00	5.4

	(US$423.20 to US$634.50)	
	4 = RM3,001.00 to RM 4,000.00 (US$634.70 to US$845.93)	4.5
	5 = RM 4,001.00 to RM 5,000.00 (US$ 846.15 to US$1,057.40)	3.6
	6 = > RM 5,000.00 (US$1,057.40)	3.6

Source: Survey Data (2022)

According to Table 6, most CGs (51.9%) were established before 2020, before the implementation of the Movement Control Order in Malaysia due to the COVID-19 pandemic. However, 48.1% of the community gardens were established in 2020. These percentages were driven by the execution of the PENJANA program by the Ministry of Agriculture and Food Industry Malaysia (MAFI), which focuses on reducing the cost of living during the pandemic (MAFI 2020).

The National Economic Recovery Plan (PENJANA) is a government initiative to restore and stimulate the national economy, helping Malaysians deal with the economic crisis during and after the COVID-19 pandemic (Ministry of Finance, 2020). In 2020, the Ministry of Agriculture and Food Industry (MAFI) allocated RM10.00 (US$2.11) million that can benefit 800 communities and 12,000 individual participants for the PENJANA Project. The implementation of the PENJANA Urban Agriculture Project aims to help reduce the cost of living for urban and suburban residents affected by the Movement Control Order (MCO) (MAFI, 2020). Following the Movement Control Order (MCO), more individuals stay and cook at home. Thus, urban agriculture is seen as an approach to help individuals and communities produce safe, fresh fruits and vegetables near their homes. In addition, this program can create social interaction and promote communication among the urban community, which can further help guarantee the country's food security.

Most CG leaders (39.6%) use investments of less than RM2,000.00 (US$422.90). Some CGs do not invest any capital, where the initial investment is from the government, private institutions, and individuals. Most CGs allocate RM500.00 (US$105.70) monthly for input and utility costs. As a result, most CGs acquire monthly sales revenue of less than RM1,000.00 (US$211.40). These indicate that most of the CG productions are sold by the direct market at a price below the current market price.

Marketing system of a community garden

Malaysia's fresh products channel usually goes through the wholesale terminal market before being sold to retailers. Only some products are marketed straight from the producer's farm to final consumers, and at least 30% of the vegetable supply would enter the export market. Trucks and lorries are mainly used for the domestic market to transport fresh vegetables from farms to final consumers. More and more individuals are investing in large and modern packaging warehouses with cold storage facilities involved in these activities. The products would be washed, graded, arranged, checked, packed, and cooled in a packaging warehouse, loaded (mostly in lorries), and sent to retailers, wholesale markets, farmers' markets, or exported (Ruslan *et al*., 2013). Efficient post-harvest handling practices of fresh productions should be enhanced for higher quality and safer vegetable products and reduced post-harvest loss throughout the supply chain.

In this research, the value chain of CG products is illustrated in Figure 6. Based on the survey conducted on 154 CGs, 62% of the CGs sell their harvested crops directly, where consumers visit the gardens and purchase them. In addition, a small number of these CGs also marketed their products to the retail markets (14%), wet markets (12%), wholesale markets (8%) and supermarkets (4%).

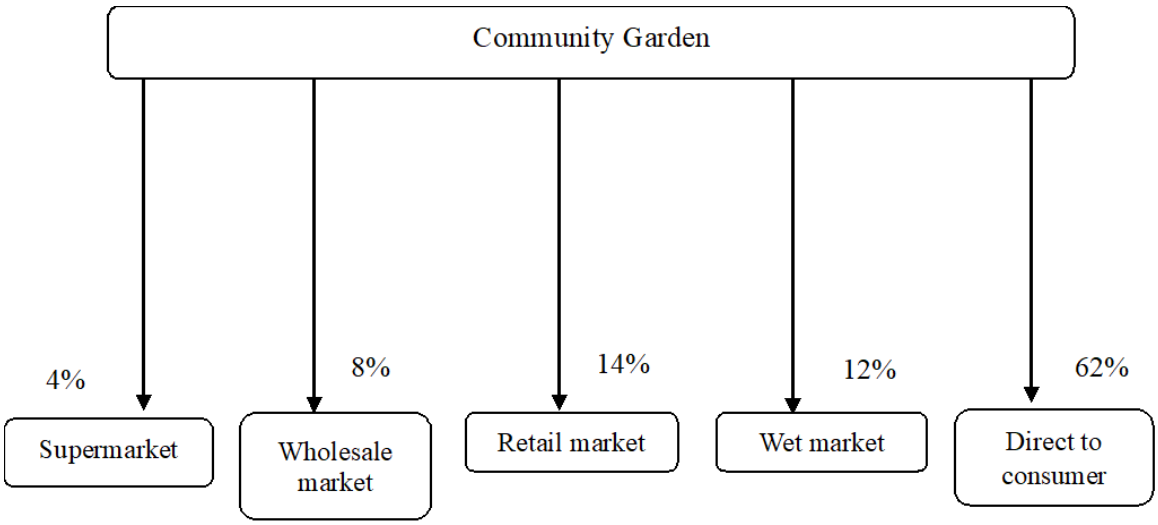

Figure 6. Marketing channel of CG products in Malaysia

The existence of CG changed this value chain to be more of a community nature. A sustainable CG contributes to productivity elevation and fulfills the rising demand. A community value chain considers the importance of coordinating manufacturers and buyers and sharing cost, risk, and return. For instance, the buyer is more involved in every stage of operation, is informed comprehensively, partially influences business decisions, contributes to finance, and participates in production, storage, and distribution. Therefore, the consumer becomes a prosumer (Toffler, 1980; Paech *et al*., 2021). A Prosumer is an individual who produces and uses their products, whereas CG members are prosumers who market their products and use the community garden's yields.

Most of the CGs in Malaysia prioritize vegetables that are often used daily. The CG leaders chose vegetables because they are short-term harvests. However, vegetables, fruits, and a few herbaceous plants are also planted and marketed. Table 7 shows the types of community garden products sold and the total monthly sales. From the table, the highest total sales are for wholesale and wet markets, with more than RM 15,000.00 (US$3,172.25), and the type of products sold is Bentong ginger. Some CGs also evolve into production hubs that can reach the local market and other markets outside their immediate area. For example, in 2021, the Community Garden in Kampung Paya Keladi Hujung, Pulau Pinang, produced more than 1,000kg/cycle of Bentong ginger.

Another example is that the community garden in Presint 17 Putrajaya produced more than 500 kg of brinjal valued at more than RM10,500.00 (US$2,220.60) for every production cycle. This model demonstrates that most of the CG has made it simple to access a variety of foods to support food availability on a neighborhood level. At the same time, some are capable of being commercialized.

Table 7. Total monthly sales and types of CG production according to marketing channels

Marketing channels (Number of community gardens)	**Total sales (RM)**	**The main types of products**
Supermarkets (*n*=7)	< RM2,500.00 (US$528.70)	Chili, kale, salad, selum, eggplant, ladies' finger, mustard leaves, basil, long beans, and turmeric
Wholesale markets (*n*=14)	< RM5,000.00 (US$1,057.40)	Chili dan selum
	RM5,000 – RM10,000	Chili, cucumber and eggplant

	(US$1,057.4 to US$2,114.8)	
	RM10,000-RM15,000 (US$2,114.8 to US$3,172.3)	Cucumber
	> RM15,000 (US$3,172.3)	Bentong ginger
Grocery (*n*= 20)	< RM5,000 (US$1,057.4)	Chili, eggplant and lemongrass
	RM5,000 – RM10,000 (US$1,057.4 to US$2,114.8)	Chili, cucumber, and eggplant
Wet markets (*n*=22)	< RM5,000 (US$1,057.4)	Chili, long beans, ladies' finger, sprouts of tubers, lemongrass, cucumber, kale, corn, flower mustard
	RM5,000 – RM10,000 (US$1,057.4 to US$2,114.8)	Cucumber and eggplant
	RM10,000-RM15,000 (US$2,114.8 to US$3,172.25)	Cucumber
	> RM 15,000 (US$3,172.25)	Bentong ginger
Direct sales (*n*=78)	< RM1,000 (US$211.5)	Baby choy sum, spinach, Brazilian spinach, ladies' finger, sweet leaf, chili, mustard, Chinese broccoli, kale, pak choy, edible fern, sprouts of tubers, cantaloupe, mustard, lemongrass, eggplant, potato
	RM 1,000 – RM 5,000 (US$211.5 to 1,057.4)	Eggplant, kale, ladies' finger, sweet potato, cucumber, chili
	RM5,000 – RM10,000 (1057.4 to US$2,114.8)	Chili, cucumber, corn, eggplant, luffa
	> RM 10,000 (US$2,114.8)	Watermelon and cucumber

Source: Survey data (2022)

CONCLUSION AND RECOMMENDATIONS

The marketing system and PF supply chain are still new practices in Malaysia. The cost of production through the PF planting technique is high compared to the conventional, which leads to the establishment of the premium market segment. Online marketing strategies using social media platforms like Facebook, Instagram, and websites are more effective for promoting plant factory crop marketing.

Direct selling is the primary marketing channel practice by CG. This model indicates that the market focus of CG products is of a community nature where the cultivated plants are for community consumption, and the selling price is also lower than the market price. Nevertheless, there are a handful of CGs that market their products to supermarkets, wholesale markets, grocery, and wet markets. In other words, despite using a new marketing approach, CG is also using the traditional marketing channels in marketing their products.

The practice of direct sales by CG or the focus on premium market segments by PF has indeed contributed to sustainability and shortening of the food supply chain. Moreover, marketing their product through direct sales means that the food comes directly from a specific farm without going through a store, market, or distributor. It reduces the distribution cost. Meanwhile, the premium market segments for PF products have benefited the consumer through its freshness and premium products. The concept of farm-to-table helps to boost the local economy and support local farmers. As farm-to-table restaurants deal directly

with the farmer, it can be sure that the money spent is going directly to helping farmers grow their businesses and is also an excellent way to make local and fresh food more available to the community.

Even though the price of PF products is higher than conventional planting, and the market focus is on restaurants and premium supermarkets, the demand for these products is growing. However, the details on consumers' acceptance of the plants cultivated in crop factories could be more extensive in Malaysia. Without consumer acceptance, every cost spent on research and development of PF would not gain any profit. Therefore, a study needs to be conducted to investigate the attitude of concern and willingness of consumers to pay for PF products and to identify the factors that influence the buying behaviors of users towards PF products. Among other suggestions that need to be considered in CG implementation is considering the social benefit factor in CG. The implementation of CG not only shortens the agro-food product's supply chain but also improves the urban community's socioeconomic status.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTIONS

Aimi Athirah Ahmad carried out the introduction and literature review sections. Nik Rahimah Nik Omar, Masnira Mohammad Yusoff and Mohammad Abid Ahmad collected and refined the data and Aimi Athirah Ahmad and Nik Rahimah Nik Omar performed the data analysis. Aimi Athirah Ahmad and Nik Rahimah Nik Omar also wrote the methodology section and finalized the findings and discussion section. All of the authors read and approved the final manuscript.