

PROFILE OF THE DRAGON FRUIT INDUSTRY AND ITS ASSISTANCE MEASURES IN TAIWAN

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ABSTRACT

Dragon fruit has been widely popular in recent years due to its fast growth rate and great adaptability. The stable price lately has also led more farmers to take part in its production. In 2016, the total cultivated area for dragon fruit in Taiwan was 2,490 hectares with a production volume of 49,108 MTs, on which a value of US\$ 95,513 was generated. The export volume in 2017 was 111 MTs, valuing US\$311.770.

The current major challenges of the dragon fruit industry are the overly rapid increase of planted area and production volume. The prospect of joining CPTPP and the tariff lowering that follows are also drawbacks in the industry. To increase competitiveness, it would be critical to improve the quality, product safety, and overall marketing stability. Establishing quality production clusters, introducing superior varieties and techniques, assisting farmers in technique improvement with onsite demonstration sessions by Technical Service Groups are some of the ways to increase the share of high quality fruits and supply consistency. Other measures like promoting organic cultivation and TAP (Traceable Agricultural Products) system would make producers accountable for their products and in turn ensure fruit safety. This way domestic fruits can be better differentiated from the imports. In terms of export, dealers are encouraged to make contracts with farmers on later production that are managed on a registry system. In addition, facilities (equipment) throughout the supply chain will also see improvement for greater competitiveness.

INTRODUCTION

Dragon fruit is adaptable to a wide range of environments and has a fast growing rate that harvest comes only 14 months after the being planted with a harvest period lasting as long as six months; it also has a unique physical appeal. After its introduction in Taiwan, the cultivation techniques for the fruit have gradually improved, resulting in higher product quality, and the advancement in regulation techniques has extended its production season. With Japan granting the access of Taiwanese white flesh dragon fruits as well as its successful introduction in other markets, dragon fruit production has seen a boom with stable prices and high margins. The low barrier of entry has attracted enthusiastic participation from farmers, and thus, the cultivated area expanded dramatically. The primary production zones are scattered throughout Taichung City, Changhua County, Nantou county, Tainan city, Chiayi county, and Pingtung and Kaohsiung areas. The fruit is harvested between May and November, but with the addition of lighting regulation technologies, it has nearly reached all-year-round production. The rapid rise in production area has made production regulation in the future inevitable. The Agriculture and Food Agency (AFA) worked proactively on setting up production clusters, logged exporting orchards, and assisted the adoption of organic or TAP systems for safety management. On the other hand, Technical Service Groups were dispatched to deliver onsite training sessions. In combination of the above measures, it is hoped that production system can maintain a stable output all-year-round to accommodate existing markets as well as sales expansion, domestic or abroad.

INDUSTRY STATUS

The record of dragon fruit cultivation in Taiwan can be dated back to 1999, when the cultivated area was only 380 hectares. The number increased steadily until it reached 1,044 hectares in 2003. The variety at the time was mainly white flesh fruit originated from Vietnam, which in combination with immature techniques, had led to unstable quality, poor texture, and unpleasant grassy taste. Consumers did not respond well to it, and many farmers rolled back on cultivation. Such trend reached its peak at 770 hectares in 2009. Since then, the introduction of new varieties and technique improvement, in addition to the import restriction on Vietnamese dragon fruits due to its revealed quarantine inconformity in March 2010, as well as the success in quarantine examination on white flesh fruits and Japan granting them the access, have provided tailwind on the demand

side. The elevated price had once again led to increase in cultivated area. In 2016, the area reached 2,490 hectares, which increased by 184% compared to the situation in 2011, with a production volume of 49,108 MTs. (Fig.1 and Table 1).

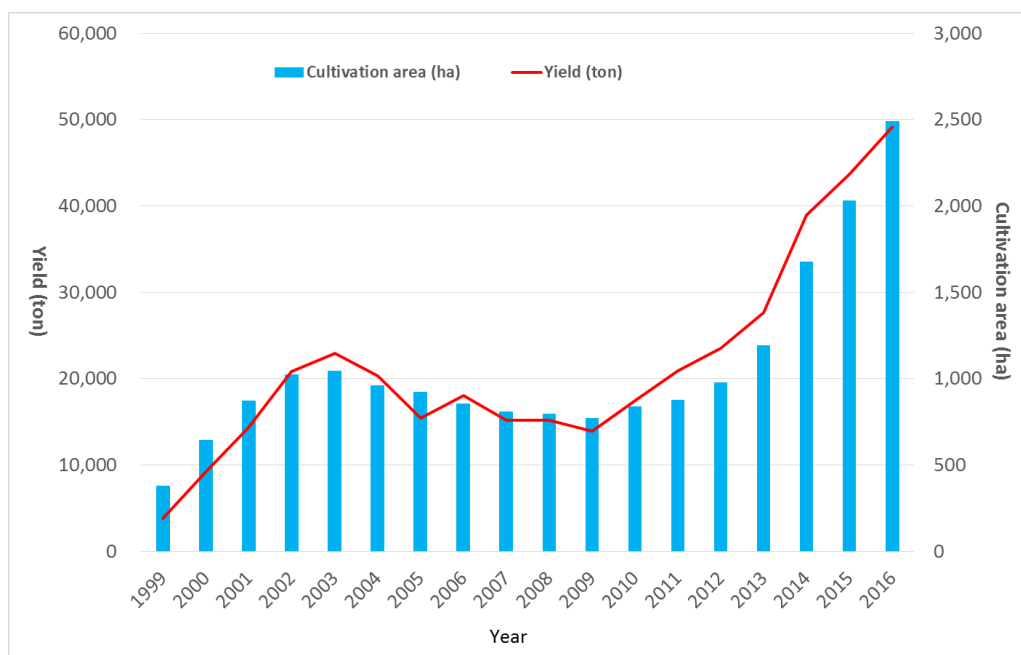


Fig. 1. The production of dragon fruits in Taiwan from 1999-2016

Table 1. The production of dragon fruits in Taiwan from 1992-2016

Year	Cultivated area(ha.)	yield (ton)	Unit price (USD)	Production value(1,000 USD)
2011	877.8	20,915	1.33	27,887
2012	979.4	23,550	1.50	35,324
2013	1,191.2	27,654	1.88	52,082
2014	1,675.9	38,965	2.32	90,464
2015	2,032.4	43,631	2.07	90,157
2016	2,490.0	49,108	1.98	95,513

Domestic dragon fruits are cultivated throughout Taiwan's Main Island and Penghu Island. The administrative district that has the largest area is in Chunghwa, which has 492 hectares, accounting for 19.8% of the country's production. The rest of the primary areas are as follows: Pingtung county, 15.2%; Nantou county, 13.8%; Tainan city, 12.9%; Chiayi county 9.8%; Taitung county, 6%; and Kaohsiung city, 4.7%. The above figures totally account for 82.2% of the overall output (refer to Table 2 for detailed areas and volumes).

Table 2. Dragon fruit production in by County and city in Taiwan

County	Cultivated area(ha.)	Harvested area (ha)	Yield per hectare (ton)	yeild (Ton)	Cultivated area ratio (%)
Changhua County	492.05	489.90	21,770	10,665,356	19.76
Pingtung County	377.45	359.51	17,037	6,124,884	15.16
Nantou County	344.07	342.47	23,635	8,094,175	13.81
Tainan city	321.03	320.68	21,506	6,896,601	12.89
Chiayi County	244.43	244.43	14,573	3,562,138	9.81
Taitung county	148.92	143.92	12,010	1,728,550	5.98
Kaohsiung city	116.43	106.81	22,127	2,363,402	4.67
Yunlin County	115.22	112.09	26,624	2,984,237	4.63
Taichung city	110.19	109.24	20,565	2,246,572	4.42
Hualien County	49.09	44.25	10,916	483,043	1.97
Yilan County	48.76	48.46	24,020	1,164,009	1.96
Miaoli County	41.14	41.14	22,906	942,340	1.65
Taoyuan city	29.36	26.66	25,209	672,085	1.18
Hsinchu County	22.46	22.46	20,457	459,453	0.90
New Taipei City	10.99	10.63	23,746	252,415	0.44
Wuhu County	10.01	10.01	21,981	220,026	0.40
Chiayi City	4.33	4.33	22,021	95,352	0.17
Hsinchu City	2.29	2.29	12,326	28,226	0.09
Jinmen County	1.70	1.70	14,000	23,800	0.07
Taipei City	0.65	0.65	14,062	9,140	0.03
Keelung City	0.02	0.02	13,200	264	0.00
Tatol	2,490.59	2,441.65	20,075	49,016,068	100.00

The cultivated varieties consist of white and red flesh. The white flesh variety is also known as Vietnamese white flesh. The red flesh variety, on the other hand, is comprised of several domestically bred varieties. These red flesh varieties are high in betacyanin pigments, making them great antioxidants. Due to its high demand, the newly cultivated area is mostly planted to red flesh varieties. The present ratio of red to white cultivated area is roughly 7 to 3.

On the export side, the volume and value have been growing steadily, from 0.18 MTs and value of US\$ 0.27 thousand in 2010 to 111 MTs and US\$ 311.77 thousand in 2017 (Fig. 2). The largest export destination is Mainland China, with a volume of 60.19 MTs (53.8 of the total), followed by Hong Kong, 44.42 MTs (39.7%) (Fig. 3).

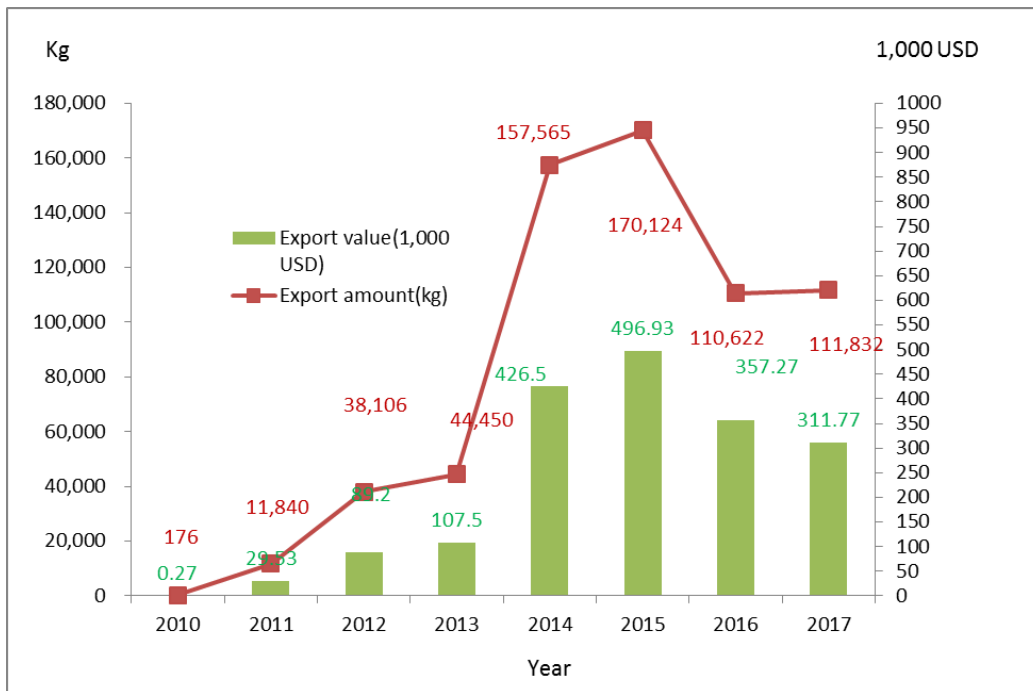


Fig.2. Dragon Fruit Exports and Values, 2010-2017

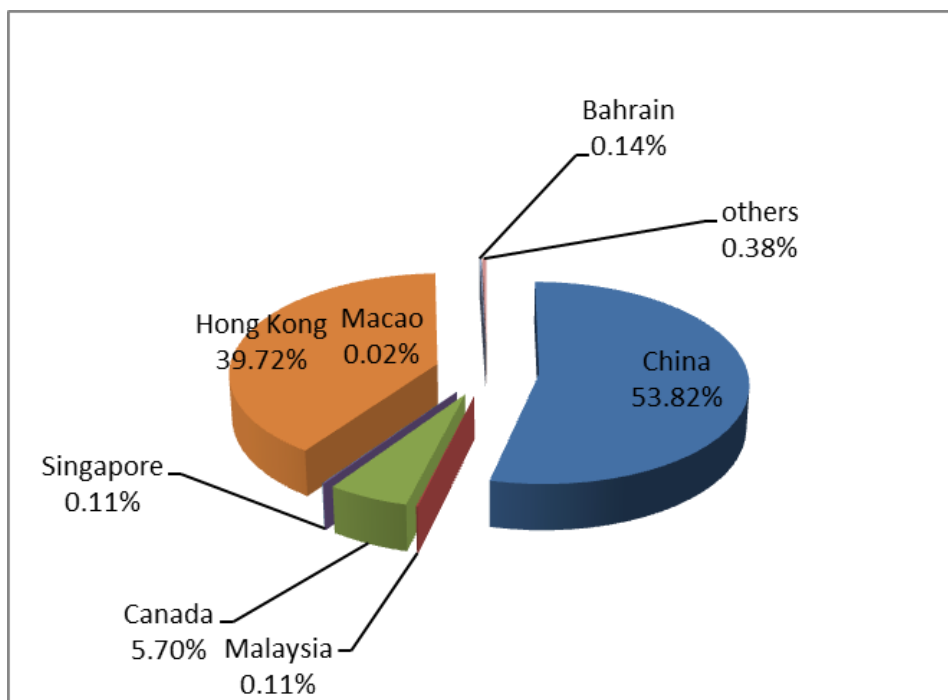


Fig. 3. Dragon Fruit Exporting Countries in 2017

As for imports, between 2010 and 2015, Taiwan imported only small quantities from Malaysia during off-season (Jan.-May). That changed with Vietnamese dragon fruits gaining access to Taiwan in Oct. 2016. The yearly imports from 2010 to 2017 were 21, 115, 278, 262, 202, 216, 678, and 814 MTs.

Data from the Taipei Wholesale Market has been a good reference point for domestic prices. According to the data, the trade volume in 1999 was 124 MTs, with an average kilogram price of US\$1.59. The average price declined along with the volume increase. By the year 2003, the volume came to 2,911 MTs but the price

dropped to US\$ 0.5/kilogram. Such drop was later reversed due to the fix of technical and quality related issues and the following consumer acceptance. In 2017, the volume reached 10,777 MTs while the unit price stayed at an elevated level of US\$ 1.42/kg (Fig. 4). According to the statistics, over the last five years, the trade volume at the Taipei Market in domestic market are mostly of the red flesh, domestic white flesh, and imported dragon fruits. The white flesh has been relatively stable; meanwhile the volume of red flesh grew a whopping 478% from 2012 to 2017, but their price gap had closed down (Table 3).

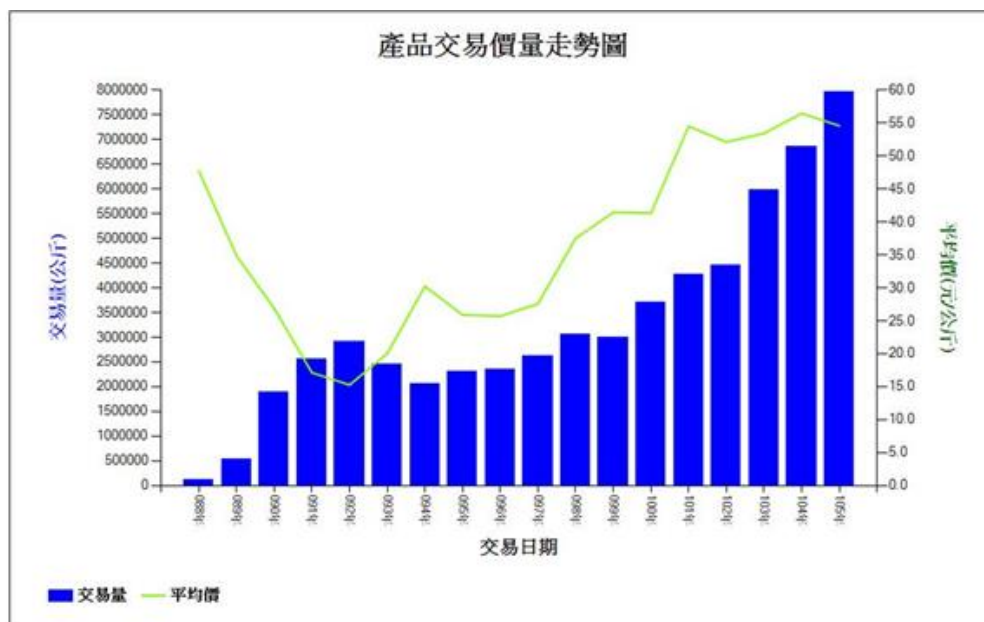


Fig. 4. Dragon Fruit in Taipei Market Comparison in 1999-2016

Table 3. Dragon Fruit Trading Volume and Average Price of Taipei Fruit and Vegetable Market in 2011-2016

Year	<i>H.polyrhizus</i>		<i>H.undatus</i>		import	
	Trading Volume (Kg)	Average Price (USD/Kg)	Trading Volume (Kg)	Average Price (USD/Kg)	Trading Volume (Kg)	Average Price (USD/Kg)
2011	801,414	1.74	2,900,458	1.28	10,106	1.88
2012	1,104,851	2.10	3,175,106	1.72	26,166	2.12
2013	1,420,986	2.14	3,047,557	1.55	14,727	1.94
2014	2,286,169	2.02	3,686,824	1.63	13,801	2.02
2015	3,296,122	2.02	3,558,329	1.75	12,778	2.29
2016	4,226,509	1.97	3,726,421	1.65	82,630	2.13
2017	6,391,299	1.53	4,385,569	1.27	104,842	1.59

Note: Imported dragon fruit is an abnormal production season in Taiwan

The eight surveys which the AFA conducted between 2006 and 2016 indicated that the cost of production was US\$ 0.65-0.75/kg, of which the wage payment accounted for the most (60%), followed by fertilizers (15%) and pesticides (4%). Of all the wage payments, harvesting and sales (23%) and pruning (23%) accounted for the most. Among others were Bagging (19%), pesticide prevention (12%), and fertilization (9%). The breakdown is shown in Fig. 5 and Fig. 6. The earning of farming households has seen increases since 2007 (Fig.7).

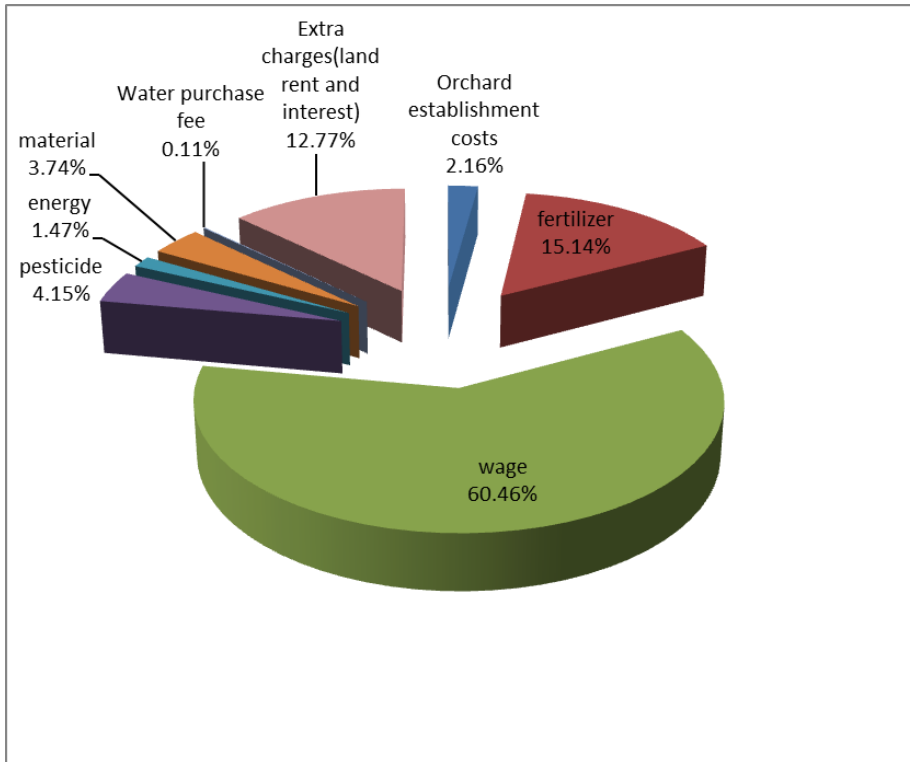


Fig. 5. Percentage of Production Costs of Cultivated Dragon Fruit in 2016

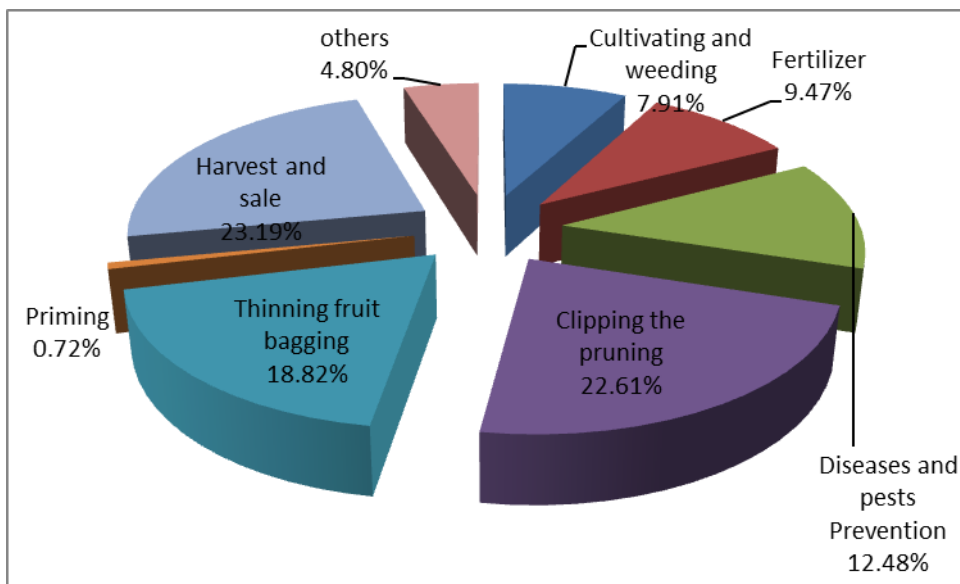


Fig. 6. Analysis of the proportion of wages in cultivation of dragon fruit in 2016

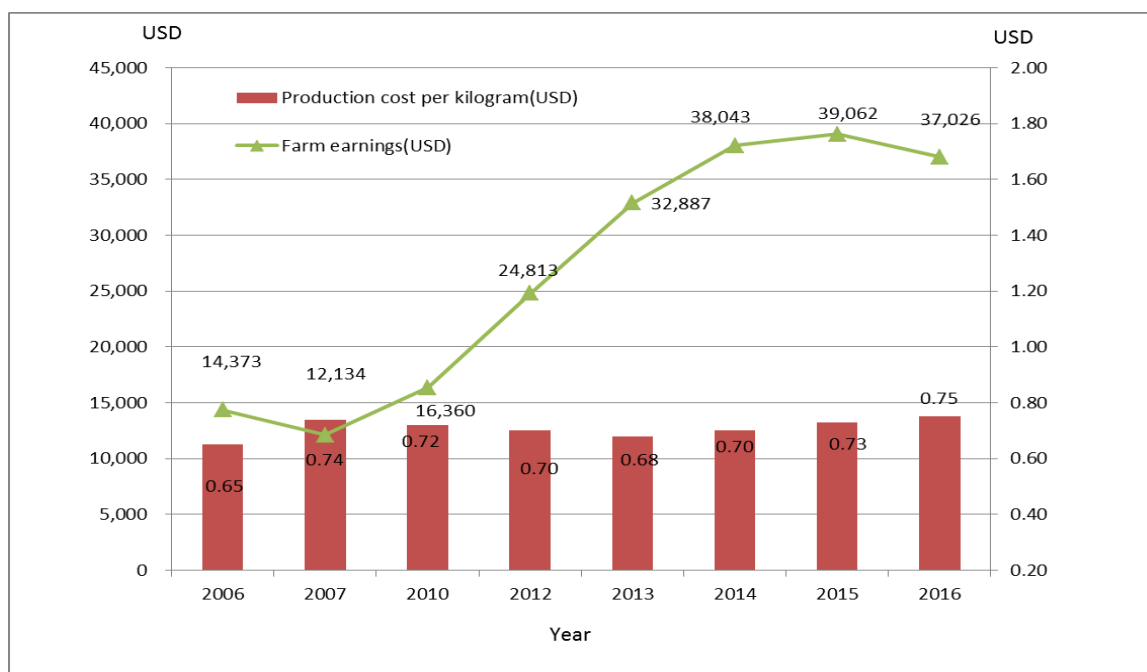


Fig. 7. Dragon Fruit Production Costs and Farm Earnings in 2006-2016

CHALLENGES

Following the improvement in varieties, cultivation techniques, and consumer appeals due to health concerns, the popularity of dragon fruits has been rising lately, which led to a growth in cultivation area. Taking into consideration all factors, including production area, production volume, export volume, and market prices, the industry is obviously on the rise. But it does have several underlying issues and concerns, as follows:

1. Over expansion due to farmers' rushing in
The cultivated area has expanded dramatically since 2009, which had reached 2,800 hectares in 2017. The demand and export only have to underperform a little to tank the price;
2. Poor use of pesticides creates concerns among consumers;
It used to be that dragon fruits required very little pesticides, which was shown by the statistics that pesticides only contributed to 3.6% of the input. Perhaps climate change, plus greater cultivation scale resulted in more pest damages. The lack of suitable pesticide recommendations and educated use of these substances could threaten the prospect of the industry
3. Production areas over divided and lack of economic of scales;
Besides Erlin Township in Changhua County that has 303 hectares of dragon fruit cultivation, no other single township has even reached 100 hectares. Such scattered production made it difficult to embark on collective pest prevention and management. The small farmer-based operation and distinct environments and farming methods have caused serious inconformity in terms of quality and inconsistency in supply. Both are not benefiting the export operation and marketing.
4. High production cost put a drag on the competitiveness
In comparison, Taiwan's wage is significantly higher than that of competitors like Vietnam, Malaysia, and Mainland China. Labor alone consisted of 60% of the production input. That factor weakened Taiwan's competitiveness in the international market.

ADJUSTMENT STRATEGIES AND SUPPORT MEASURES

Recent high prices spurred the interest of farmers in dragon fruits. The volume increase has made the price drop very likely. Dragon fruits from Malaysia and Vietnam are imported mainly during non-production seasons. Facing the potential accession to CPTPP and the decrease in tariff that follows, the support measures below were formulated to maintain the industrial competitiveness:

- Strengthen the supply chain management of export fruit supplying orchards;
Advising dealers to reach contracts with producers on the coming harvest, which are then logged on to registry system for management. To date, such contract-based orchards total 14.32 hectares. They not only embark on environment and facility improvement, but registry and barcode tracing systems were also adopted for better supply chain management, which would elevate the quality and consistency of their fruits.
- Establish quality production clusters
For improvement in the quality of domestic dragon fruits and higher operation efficiency, APMGs and production units in close proximity are encouraged to join together and collectively adopt advantageous varieties and techniques. They can also apply pesticide collectively to produce better fruits at a steady rate. Thus far, a total of five clusters have been established in Changhua, Tainan, Hualien, and Taitung, with a joint area of 70.29 hectares.
- Promote the cultivation management and safe use of pesticides:
Technical Service Groups were established to deliver educational sessions to farmers. In those events, safe use of pesticides was strongly emphasized for the safety of end products. It is expected that 15 lectures and onsite demonstrations and two educational sessions in consumption regions are to be carried out for domestic marketing. Fenshang Tropical Horticultural Experiment Branch has been conducting annual fruit evaluations since 2011 to give guidance on fruit quality.
- Introduction of safety labels and certification:
Along with the emphasis on food safety by consumers and international societies alike, farmers are advised to use pesticide with greater safety consciousness and adopt TAP or organic system. The latter allows food products to be traced back to producers and creates accountability. Through which, the consumer confidence, brand reputation, and market differentiation can all be improved.
- Enhance domestic sales and the idea of local production local consumption
In prime seasons, supermarket of farmers' associations and wholesale in collaboration with relevant farmers' groups will strengthen their buying and marketing efforts. Fresh dragon fruits are shipped to wholesale markets for auction through collective marketing to reduce the markup. Farmers' groups are also guided to accompany their sales events with leisure activities, tourism, and industrial culture to enlarge the buying interest.
- Develop postharvest treatment and storage techniques to prolong the fruit storage life and quality
The AFA has been entrusting and funding universities to conduct research in improving the postharvest treatment and storage techniques for dragon fruits. It is hoped that dragon fruits can in the future be preserved longer while maintaining the same freshness to accommodate markets overseas.
- Diversify the dragon fruit varieties and use lighting to manipulate and prolong production periods:
Normally dragon fruits are produced between May and Nov. Now with the help of new varieties and lighting regulations, it can be produced nearly all-year-round. It is hoped that these measures can help diversify production and relief the pressure of unloading stocks in prime seasons.
- Adopt facility cultivation for seasonal diversification and product safety
Since 2014, net houses with horizontal scaffolds for dragon fruits have been included into the subsidized items. They proved to be effective in increasing the production in winter and saving the cost of bagging, pesticide application, and paper bags. As the result, the safety rose along with the operation efficiency.

CONCLUSION

Dragon fruit is a vital and newly emerging fruit produce in Taiwan. It is highly nutritious as well as great in taste and health preservation functions. The production and market situation is changing in recent years. In response, it would be essential to diversify and promote seasonal regulations. Also, the effort in promoting certification for greater safety management can lead to better product safety and protect consumer interest. As a result, Taiwan's dragon fruit can gain an image of being safe and healthy. Domestic sales can be facilitated with the promotion of local production, local consumption. Before each prime season, consumers are to be informed about the nutritious value of dragon fruits as well as how to pick, preserve, and make the best use of the fruit. Knowledge leads to action, which in this case, refers to purchasing. Other means like diverse marketing and packaging improvement can also lead to higher sales and better per unit prices. In terms of export, the effort on registry and traceability system for export supplying orchards as well as production clusters are going to continue, which in

addition to improvement in logistic systems and advancement in storage techniques can make products more competitive internationally, as only with healthy balance between production and marketing, Taiwan's dragon fruit industry can have a sustainable development.

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