



Kingdom of the Netherlands

Report on Large-scale Modern Greenhouses

Greenhouse horticulture in Japan

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Shibakoen | Minato-ku | Tokyo | 105-0011

2018

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THE ACTUAL STATUS OF PROTECTED HORTICULTURE IN JAPAN

The actual status of protected horticulture in Japan

1.1 Transition of the installation area and the total cultivation area of horticultural facilities

The installation area and the total cultivation area has declined steadily in the past decade. The installation area has decreased from 52,288 to 43,232 hectares and the total cultivation area has declined with nearly 20%, from 66,051 to 53,249 hectares. Greenhouses account for about 90% of these facilities, of which a small number consists of glasshouses containing vegetables, fruits, flowers, and plants.

Facility		Year						
		2003	2005	2007	2009	2012	2014	
Total of glasshouse and greenhouse	Actual installation area	Vegetables	36,278	36,240	35,237	33,890	32,469	30,330
		Flowers and plants	8,693	8,607	8,079	7,745	7,188	6,500
		Fruits	7,318	7,362	7,291	7,414	6,791	6,402
		Total (ha)	52,288	52,209	50,608	49,049	46,449	43,232
	Total cultivation area	Vegetables	48,513	49,565	47,217	46,052	41,948	39,635
		Flowers and plants	10,328	10,632	10,564	9,232	8,090	7,412
		Fruits	7,210	7,656	7,100	6,898	6,189	6,202
		Total (ha)	66,051	67,853	64,880	62,182	56,226	53,249
Glasshouse	Actual installation area	Vegetables	889	911	873	811	797	753
		Flowers and plants	1,242	1,206	1,145	1,096		862
		Fruits	146	145	139	131	962	43
		Total (ha)	2,277	2,262	2,157	2,039	1,889	1,658
Greenhouse	Actual installation area	Vegetables	35,389	35,329	34,364	33,079	31,672	29,577
		Flowers and plants	7,451	7,401	6,935	6,649	6,227	5,638
		Fruits	7,172	7,217	7,153	7,282	6,661	6,359
		Total (ha)	50,011	49,947	48,451	47,010	44,560	41,574
	Total cultivation area	Vegetables	7,538	7,887	7,038	6,639	5,086	4,929
		Flowers and plants	1,079	1,166	1,071	1,190		851
		Fruits	5,112	5,141	5,330	5,709	687	4,808
		Total (ha)					5,138	

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Covered facility Actual installation area	Total (ha)	13,728	14,194	13,439	13,538	10,927	10,587

Source: Statistics about the status of horticultural facilities, Ministry of Agriculture, Forestry and Fisheries

Outline and status of protected horticulture

There are two types of facilities available; tunnels and houses. Increasing interest has been shown to facilities with high-level climate controls. Especially in Japan, where there is difficulties in cultivation in summer (due to high temperatures and typhoons) the trend in protected horticulture has been rising in recent years. The introduction of climate control would allow for the forwarding period to be extended. Despite these recent developments, the reality is that the yield per unit area has not improved. This can be attributed to the fact that the development and subsequent expansion of technology has only been sufficient for temperature control and not high-level climate control, mainly because pipe house cultivation remains the most popular form of horticulture in Japan. Overall, the situation seems to be improving with the increased use of greenhouses over plastic tunnels and covered facilities. Nevertheless, high-tech has still not been developed to a sufficient capacity as found in the fact that only 40.3% of greenhouses have warming devices, and that only 2.2% of greenhouses have devices to control multiple climate conditions such as temperature, humidity, and light. It is imperative to increase the rate of greenhouses with climate controls as this will allow for improved productivity by ensuring a stable supply of fresh produce irrespective of weather.

Comparison with Netherlands

In Japan, the number of farm households engaged in protected horticulture have been decreasing every year due to aging. As the facility area per household has not changed from about 20 ha, and the size has not been expanded, facility installation area has been decreasing. On the other hand, in the Netherlands, the facility area per household has been increasing annually, which means that facilities have generally been getting larger.

Status of facilities with hi-tech devices

		2013	2015
With multi-condition controller	Glasshouse ha	179	-
With multi-condition controller	Greenhouse ha	476	-
Sub-total (ha)		655	952
Without multi-condition controller	Glasshouse ha	1,710	1,658
Without multi-condition controller	Greenhouse ha	44,084	41,574

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Sub-total (ha)	45,794	42,280
Total (ha)	46,449	43,232
Greenhouse with heating device (ha)	20,002	17,406
Greenhouse with carbon dioxide generator (ha)	1,448	1,404
Greenhouse with solution-culture facility (ha)	1,848	1,826

Source: The actual status of protected horticulture, Ministry of Agriculture, Forestry and Fisheries

1.2 The actual status of protected horticulture

With regards to the number of farm households engaged in protected horticulture by cultivated item, vegetables boast the largest number of items (73.3%) followed by flowers and plants (17.1%) and then fruits (9.6%).

Regarding the facility installation area, 10 – 30 a and 30 – 50 a account for about 25% each and over 1 ha accounts for 16.8%.

Transition of the number of farm households growing vegetables, flowers and plants, and fruits

Year	2005	2010	2015	
Cultivation area (ha)	44,602	41,312	35,185	%
Farm households (ten thousand)	202	180	146	100.0
Vegetable growers (ten thousand)	145	130	107	73.3
Flower growers (ten thousand)	38	32	25	17.1
Fruits growers (ten thousand)	19	18	14	9.6

Facility installation area by size (a)

	2005	2010	2015	%
Less than 10 a	2707	2249	2207	6.3
10~30 a	13853	11977	9754	27.7
30~50 a	11822	10692	8564	24.3
50~1 ha	10807	10479	8743	24.8
More than 1 ha	5413	5915	5917	16.8
ha	44602	41312	35185	100.0

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In consideration of the above situation, the Ministry of Agriculture, Forestry and Fisheries has carried out measures to promote strong agriculture as well as next-generation protected horticulture.

1.3 Next-generation protected horticulture

The two main measures to promote strong agriculture are the structural reorganizations for protected horticulture and the development of bases for next-generation protected horticulture.

Objectives

- Learn from horticulture-developing countries such as the Netherlands, and utilize our own resources and technology while building up more facilities on an unprecedented scale
- Break away from dependence on fossil fuels by means of utilizing domestic advantaged woody biomass and others (utilizing regional energy)
- Build up production/distribution systems with computerized climate control with the purpose of providing stable production throughout the year. This in turn should lead to the realization of a new protected horticulture that reduces costs and creates regional employment.

Promotional activities for the regional development of next-generation protected horticulture (started in 2016):

- Transmitting information about seminars and other developments concerning the effects of the bases of next-generation protected horticulture
- Support for human resource development such as practical training at the bases
- Expanding next-generation protected horticulture to each region utilizing knowledge gained at the bases
- Bonus for strong agriculture: Support developing large-scale cultivation facilities with high-level climate control systems that utilize regional energy and advanced technology

The FY2018 budget of the Ministry of Agriculture, Forestry and Fisheries:

- 1,406 million yen to support the creation of new production areas
- 2,362 million yen to support business expansion for next-generation protected horticulture
- 2,000 million yen as a bonus for building strong agriculture

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The actual status of protected horticulture

Base and model district facility	Production item and cultivation area	Energy source	Target yield
Tomakomai City, Hokkaido	Strawberries	4 ha	314 ton 7.5 ton/10 a
High-eave and high-ridge greenhouse	Woody biomass		
Ishinomaki City, Miyagi	Tomatoes	1.1 ha	370 ton 34 ton/10 a
	Paprika	1.3 ha	260 ton 20 ton/10 a
Venlo greenhouse	Woody biomass, earth heat		
Kuki City, Saitama	Tomatoes	3.3 ha	990 ton 30 ton/10 a
Low-height and high-density cultivation	Woody biomass		
Oyama-cho, Shizuoka	Tomatoes (high sugar degree)	3.2 ha	228 ton 7.1 ton/10 a
	Cherry tomatoes	0.8 ha	24 ton 3 ton/10 a
Low-height and high-density cultivation	Woody biomass		
Toyama City, Toyama	Tomatoes	2.9 ha	505 ton 17.7 ton/10 a
	Flowers incl. showy prairie gentian	1.2 ha	1430 thousand stems
Waste heat with thermal storage container	Waste-derived fuel		
Kasai City, Hyogo	Tomatoes	1.8 ha	630 ton 35 ton/10 a
	Cherry tomatoes	1.8 ha	360 ton 20 ton/10 a
Long-term multistage cultivation	Woody biomass		
Toyohashi City Aichi	Cherry tomatoes	3.6 ha	726 ton 21 ton/10 a
High-eave and high-ridge greenhouse	Final effluent heat of sewage farm		
Shimanto-cho Kochi	Tomatoes	4.3 ha	1,651 ton (38 ton/10 a)
High-eave greenhouse	Woody biomass		

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Kokonoe-cho, Oita	Paprika	2.4 ha	393 ton (16.3 ton/10 a)
Earth heat energy	Hot-spring heat		
Kunitomi-cho, Miyazaki	Bell pepper	2.3 ha	345 ton 15 ton/10 a
	Cucumbers	1.8 ha	450 ton 25 ton/10 a
	Woody biomass		

OVERVIEW BY INDIVIDUAL CULTIVATION ITEM

Overview by individual cultivation item

The crop acreage for the yield of tomatoes, cucumbers, strawberries, paprika, flowers, and plants are as follows:

The crop acreage of cucumbers has been decreasing, from 12,500 ha in 2008 to 10,770 ha in 2017. So has the crop acreage of strawberries, which has declined from 6,470 ha to 5,370 ha. Tomato crop acreage picked up in 2015, but is still on an overall declining trend. Productivity on the other hand has been increasing gradually for the last decade, seeing an output of 61.4 tons of tomatoes, 52 tons of cucumbers and 29.6 tons of strawberries. The crop acreage and production quantity of flowers and plants have been on the decline in all the categories.

Trend of tomatoes, cucumber and strawberries		2008	2010	2013	2015	2017
Yield (ton)	Tomatoes	732,800	690,900	747,500	727,000	737,200
	Yield per ha	58.6	56.2	65.6	60.1	61.4
	Cucumbers	627,400	587,800	574,400	549,900	559,600
	Yield per ha	50.192	48.6	50.4	50.0	52.0
	Paprika	3,057	2,663	3,996	3,649	*
	Yield per ha	50.1	42.3	56.3	57.0	*
	Strawberries	190,700	177,500	165,400	158,700	159,000
	Yield per ha	29.5	28.9	29.5	29.1	29.6
	Total	1,553,957	1,458,863	1,491,296	1,439,249	1,455,800
Crop acreage (ha)	Tomatoes	12,500	12,300	11,400	12,100	12,010
	Cucumbers	12,500	12,100	11,400	11,000	10,770
	Paprika	61	63	71	64	*
	Strawberries	6,470	6,150	5,600	5,450	5,370
	Total	31,531	30,613	28,471	28,614	28,150

*no data available

Trend of flowers and plants		2008	2010	2013	2015	2017
Crop acreage (ha)	Cut flowers	16,840	16,200	15,380	14,820	14,460
	Bulbs	564	505	414	364	317
	Potted plants	1,963	1,859	1,796	1,732	1,675
	Seedlings for flower beds	1,640	1,569	1,531	1,488	1,451
	Total	21,007	20,133	19,121	18,404	17,903

OVERVIEW BY INDIVIDUAL CULTIVATION ITEM

	Cut flowers	473,400	435,100	406,600	386,700	370,400
Yield (ten thousand)	Bulbs	15,720	14,950	12,660	10,200	9,110
	Potted plants	28,400	26,120	24,730	22,960	22,120
	Seedlings for flower beds	77,720	72,170	71,450	66,600	60,960
	Total	595,240	548,340	515,440	486,460	462,590

Source: Extraction from the production statistic of vegetables and others, Ministry of Agriculture, Forestry and Fisheries

2.1 The status of paprika

Despite the increase in the domestic yield of paprika (from 2,322 tons in 2006, 3,057 tons in 2008, 3,792 tons in 2014 and 5,400 tons in 2017), imported paprika still accounts for nearly 90% of the market.

	The imported/domestic yield in 2014	2017
Korea	63% 23,888 ton imported	70% 34,362 ton imported
Netherlands	15% 5,687 ton imported	11% 5,400 ton imported
New Zealand	12% 4,550 ton imported	8% 3,927 ton imported
Japan	10% 3,792 produced, 64 ha of crop acreage	11% 5,400 produced, 78 ha of crop acreage
Total	37,917 ton Korean unit price: 373 yen Average unit price of the imported: 407 yen/kg	49,089 ton Korean: 302 yen Average of the imported: 338 yen/kg

In 2014 the yield of paprika in Japan was 3,792 tons, the crop acreage was 64 ha, and the yield per ha was 59 kg. This increased to 5,400 tons, 78 ha and 69 kg in 2017, which shows that the yield per ha increased by 10 kg.

Characteristic of the market:

The paprika market is peculiar in that it was initially established through imports and domestic production only developed later. Between 2014 and 2017 the yield increased by 1,600 tons and the crop acreage increased by 14 ha.

Crop acreage of domestic paprika

	2014		2016	2017	
Crop acreage	64 ha	59 kg per ha	69 ha	78 ha	69 kg per ha

Crop acreage of paprika by prefecture

2006 (ton /10a)			2008			2014 (ton /10a)		
Prefecture	Crop acreage	Yield	Prefecture	Crop acreage	Yield	Prefecture	Crop acreage	Yield

OVERVIEW BY INDIVIDUAL CULTIVATION ITEM

Kumamoto	12	635 (5.3)	Kumamoto	8	503	Ibaraki	11	856 (7.8)
Gunma	6	41 (0.7)	Nagano	6	309	Miyagi*	9	1,023
Nagano	6	198 (3.3)	Ibaraki	6	422	Kumamoto	6	(11.4)
Hiroshima	5	163 (3.3)	Yamagata	6	231	Yamagata	6	289 (4.8)
Yamagata	4	210 (5.3)	Hiroshima	5	177	Nagano	5	271 (4.5)
Miyagi*	3	55 (1.8)	Okinawa	3	64	Gunma	5	224 (4.5)
Ibaraki	3	217 (7.2)	Aomori	3	128	Shimane	3	142 (2.8)
Kochi	3	241 (8.0)	Gunma	3	103	Miyazaki	2	55 (1.8)
Hokkaido	2	98 (4.9)	Kochi	3	215	Oita	2	127 (6.4)
Shimane	2	10 (0.5)	Miyazaki	2	158	Iwate	2	88 (4.4)
Others	10	455 (4.6)	Others	-	-	Others	13	39 (2.0)
								1,160 (8.9)
Total	56	2,323 (4.1)	Total	61	3,057	Total	64	4,274 (6.7)

Source: From the production status of local specialty vegetables, Ministry of Agriculture, Forestry and Fisheries
*In Miyagi new facilities were introduced for the disaster recovery

2.2 Cost composition of paprika

Case of T Agricultural Corporation in Ibaraki: the cost for 1kg of paprika

Production cost

The cost composition (419 yen) for the production of paprika of T Corporation is as follows: the labor cost (89 yen, 21.1%) and the consignment fee (17 yen, 4.1%) account for 25.2% (106 yen), followed by the fuel/utility cost (60 yen, 14.3%), the material cost (45 yen, 10.7%), the fertilizer cost and the pesticide cost (21 + 13 = 33 yen, 8.1%), then the breeder cost (16 yen, 3.8%). The most expensive is depreciation (119 yen, 28.4%).

Depreciation	119	28.4%
Labor cost	89	21.2%
Fuel/power utility cost	60	14.3%
Material cost	45	10.7%
Fertilizer cost	21	5.0%
Breeder cost	16	3.8%
Pesticide cost	13	3.1%
consignment fee	17	4.1%
Land rent/house rent	15	3.6%
Packing charge, commission	8	1.9%
Repair cost	5	1.2%
Others	11	2.6%
Total (yen)	419	100.0%

General management cost

The ratio of the executive salaries and the sales commission is high, accounting for 63.6% of the general management cost of 118 yen.

Executive salaries	44	37.3%
Sales commission	31	26.3%

OVERVIEW BY INDIVIDUAL CULTIVATION ITEM

Tax and public dues	8	6.8%
Travel cost	6	5.1%
Car expense	6	5.1%
Insurance cost	5	4.2%
Depreciation	4	3.4%
Others	14	11.9%
Total (yen)	118	100.0%

2.3 The production cost of cucumbers and tomatoes

The cost composition of cucumbers, large-size tomatoes cropped in winter and spring, and cherry tomatoes cropped in summer and autumn is as follows: Out of the cost composition of cucumbers (383 yen/10 a) the ratio of depreciation (101 yen, 26.4%) is the largest, followed by the fertilizer cost (97 yen 25.3%), breeder cost (47 yen, 12.3%) and then power utility cost (46 yen, 12%).

	Facility for cucumbers		Facility for large-size tomatoes				Facility for cherry tomatoes	
	(Summer, autumn)	Ratio %	(Winter, Spring)	Ratio %	(Summer, autumn)	Ratio %	(Summer, autumn)	Ratio %
Labor cost	18	4.7%	39	3.3%	6	1.6%	310	32.4%
Breeder cost	47	12.3%	65	5.5%	23	6.0%	62	6.5%
Fertilizer cost	97	25.3%	377	32.1%	126	33.1%	231	24.1%
Power utility /water cost	46	12.0%	395	33.6%	19	5.0%	26	2.7%
Depreciation	101	26.4%	152	12.9%	115	30.2%	239	25.0%
Packing / transportation cost	74	19.3%	148	12.6%	92	24.1%	89	9.3%
Total (yen)	383	100.0%	1176	100.0%	381	100.0%	957	100.0%

Source: The production cost per 10 a of main vegetables, Ministry of Agriculture, Forestry and Fisheries Note: Depreciation includes agricultural implements and facilities. Fertilizer cost includes pesticide and material costs.

There is a large difference of composition between large-size tomatoes cropped in winter and spring and cherry tomatoes in summer and autumn. Though the breeder costs don't differ so much between 65 yen (large-size) and 62 yen (cherry-size), there are big differences between the two in labor costs, fertilizer costs and the power utility costs. The labor cost of cherry tomatoes is 310 yen which is nearly ten times that of large-size tomatoes (39 yen). The fertilizer cost (377 yen, 32.1%) and power utility (395 yen, 33.6%) of large-size tomatoes are expensive compared to those of cherry tomatoes at 231 yen and 26yen respectively.

OVERVIEW BY INDIVIDUAL CULTIVATION ITEM

2.4 The market outline of flowers and plants

Article 2 of the *Flowers and Plants Promotion Act* defines “flowers and plants” as plants provided for ornamental purposes. Specifically, they refer to cut flowers, potted plants, flowering trees and shrubs, flower bulbs, seedlings for flower beds, lawn grass and ground-covering plants. Flowers and plants are items with extremely high palatability as they have high range in their kind, breed, and color depending on the purpose and an occasion. They are used for a variety of occasions such as at wakes and weddings, and as presents and ornaments.

	Production amount in 2016	Use application
Chrysanthemum	69.2 billion yen	Funerals, offerings
Orchid (potted)	33.3 billion yen	Celebrations
Lily	21.7 billion yen	Ornaments, offerings
Rose	19.0 billion yen	Anniversaries, Weddings
Potted plants / trees and shrubs	16.8 billion yen	
Cut flowers	15.1 billion yen	Flower arrangements
Seedlings for flower beds	14. billion yen	Flowery town development
Carnation	12.6 billion yen	Mother’s Day
Others / Total	380.1 billion yen	Cut flowers 218.2 billion yen, potted plants 95.9 billion yen

- The domestic shipment of cut flowers is 3.87 billion stems (75%) and the imported shipment is 1.27 billion stems (25%). The item with the highest import percentage is carnations which account for 56% and are imported from Colombia and China. Next are roses with 18%, followed by chrysanthemum which is 16%.
- The domestic shipment of flower bulbs is about 100 million accounting for 22%. The imported shipment is 360 million, of which 310 million are from the Netherlands. Domestic production areas are in Kagoshima, Niigata, and Toyama where 2,000 to 3,000 bulbs are shipped in each area.

The characteristic of the market

The Institute of Vegetable and Floriculture Science, NARO, has been developing technologies which are difficult for private companies to implement, such as (1) measures for low-cost and energy-saving, and (2) improvements in longevity and disease endurance. Despite this the breeding by private companies and producers has been flourishing.

Production cost in comparison with that of Colombia

	Japan	Colombia
Fuel/oil	26 – 27.000 yen per year	0
Facility cost per 10 a (pipe house)	3.7 to 3.8 mln. yen	240 to 250.000 yen (woody polyethylene fil)
Labor cost	130.000 yen per month	25 to 30.000 yen per month
Production cost per stem	28.7 yen	14 cent (14 yen)

OVERVIEW BY INDIVIDUAL CULTIVATION ITEM

Transportation cost (production area to market)

10.4 yen

13 to 15 cent (Bogota → Narita)

References

Tomatoes: the gross yield

<https://japancrops.com/crops/tomato>

Although the domestic gross yield of tomatoes increased by 2% between 2006 and 2016, the crop acreage declined by 6.2%.

The yield of tomatoes per 10 increased by 8.5% domestically.

Cucumbers: the gross yield

<https://japancrops.com/crops/cucumber>

The domestic gross yield of cucumbers decreased by 12.4% between 2006 and 2016, and the crop acreage also declined by 16.8%.

The yield of cucumbers per 10 increased by 5.2% domestically.

Strawberries: the gross yield

<https://japancrops.com/crops/strawberry>

The domestic gross yield of strawberries decreased by 16.6% between 2006 and 2016, and crop acreage also declined by 20.9%.

The yield of strawberries per 10 increased by 5.3% domestically.

The paprika market (transition of import volume)

Case study of paprika production, Graduate School of Life and Environmental Sciences, University of Tsukuba:

Paprika was first imported from the Netherlands in 1993 and almost had a complete monopoly in the Japanese market until 2000. Due to its rarity it was an expensive vegetable. In 1999 Korea first tested exporting paprika to Japan and in 2000 expanded its export volume to a commercial rate. The import increase from Korea led to a decline in prices and allowed the vegetable to spread to local supermarkets, popularizing it as an ingredient. The entire import volume in 2010 was 25,411 tons, of which Korean export accounted for 16,252 tons, or, 64%.

