Situation of Greenhouse Horticulture

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Ministry of Agriculture, Forestry and Fisheries
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1. Status of greenhouse horticulture (1)

- Horticultural crops, such as vegetables, fruits and flowers, account for some 40% of Japan's agricultural production in value. As they have a strong potential to become high value-added products through growers' ingenuity, they form an important and attractive field chosen by 85% of new farmers.

- In terms of consumption, they constitute an important item of national consumptive life as they account for the largest portion of spending of foodstuffs in value. Stable, year-round supply of products by greenhouse horticulture is indispensable to meet consumer needs.

- As prices of vegetables are greatly affected by the supply, the stabilization of supply by means of greenhouse horticulture is important for, among other things, the protection of national food consumption.

**Japan's agricultural output**

- Rice: 1.6549 trillion yen (18.0%)
- Livestock: 3.1626 trillion yen (34.4%)
- Vegetables: 2.5567 trillion yen (27.8%)
- Fruits: 833.3 billion yen (9.1%)
- Flowers: 352.9 billion yen (3.8%)
- Tubers: 237.2 billion yen
- Beans: 55.4 billion yen
- Wheat and barley: 31.2 billion yen
- Other: 318.3 billion yen

**Vegetables 66%**

(of which, vegetables grown by greenhouse horticulture: 25%)

- Livestock products 3%
- Other 3%
- Paddy rice, wheat, cereals and beans 9%

**Yearly amount of spending on foodstuffs per household**

- Eating out: 18%
- Seafood: 8%
- Meat: 10%
- Milk and eggs: 5%
- Vegetables and seaweeds: 11%
- Confectionery: 9%
- Prepared foods: 13%
- Seasonings: 5%
- Drinks: 6%
- Liquors: 4%

**Situation of relay-like shipments of tomatoes in season from production regions**

- August: Open field and rain cover
- September: Produced in Ibaraki and Chiba
- October: Greenhouse (warming)
- November: Late November to early December
- December: Prices rise 33% when amount of arrival drops 12% between later November and early December
- January: Early January 2013, Early January 2012
- February: Early February
- March: Early March, Early February
- April: Early April, Early March

**Changes in wholesale prices of green bell peppers and amount of arrival at Metropolitan Central Wholesale Market**

Greenhouse horticulture is important for the stable supply of vegetables!
1. Status of greenhouse horticulture (2)

- Greenhouse horticulture is being undertaken for a variety of products and has captured extremely high production shares for certain products.
- Greenhouse horticulture of vegetables is highly labor-productive and can generate earnings even on small areas of land as its income per 10a is roughly three times that of open-field culture.

<table>
<thead>
<tr>
<th>Product</th>
<th>Protected cultivation Gross area (ha)</th>
<th>Share of production (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomatoes</td>
<td>6,971</td>
<td>74</td>
</tr>
<tr>
<td>Spinach</td>
<td>4,325</td>
<td>24</td>
</tr>
<tr>
<td>Strawberries</td>
<td>3,970</td>
<td>88</td>
</tr>
<tr>
<td>Cucumbers</td>
<td>3,525</td>
<td>61</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product</th>
<th>Gross profit (in 1,000 yen)</th>
<th>management cost (in 1,000 yen)</th>
<th>Income (in 1,000 yen)</th>
<th>Working time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse cultivation of vegetables</td>
<td>1,082</td>
<td>620</td>
<td>462</td>
<td>338</td>
</tr>
<tr>
<td>Open-field cultivation of vegetables</td>
<td>396</td>
<td>238</td>
<td>158</td>
<td>191</td>
</tr>
<tr>
<td>Cultivation of fruits</td>
<td>475</td>
<td>291</td>
<td>183</td>
<td>211</td>
</tr>
<tr>
<td>Cultivation of rice</td>
<td>119</td>
<td>103</td>
<td>16</td>
<td>33</td>
</tr>
</tbody>
</table>

Source:
Statistics on Management by Farming Type, 2014 MAFF
While greenhouse horticulture accounts for the majority of tomato production, output per 10a in the Netherlands has increased since the 1980s due to the widespread practice of hydroponic systems and CO₂ generators. In particular, it has increased drastically since 1985, when computer-based environmental control technology advanced.

The yield per 10a in Japan, meanwhile, has stalled at a low level.

Reasons for drastic yield growth
- Rapid increase in practice of hydroponic systems
- Improvements in structure of protection facilities and methods of pruning in horticulture, and cultivar improvements matching them
- Application of carbon dioxide
  Advances in environmental control technology (since 1985) by computer (MS-Windows)

Sources: The Netherlands: FAOSTAT, Japan: Vegetable production shipment statistics (winter-spring tomatoes)
To extend periods for which agricultural products including vegetables can be shipped, horticulture in Japan has advanced from vinyl tunnels and rain covers to greenhouses and devices to control temperatures in greenhouses.

While greenhouses occupy a total area of 43,232ha, greenhouses equipped with devices to warm them and those capable of controlling light and other environmental factors account for 17,406ha (40.3%) and 952ha (2.2%), respectively.

To ensure a stable supply of vegetables and other food regardless of weather conditions, it is important to raise the ratio of greenhouses equipped with environmental control devices and improve productivity.

### Area of greenhouses in Japan (2014)

- **Greenhouses 43,232ha**
  - Glass House 1,658ha
  - Plastic House 41,574ha
  - Ordinary Pipe House 42,280ha
  - **Plant Factory with Artificial Light (PFAL)** 29ha
  - **GH with Advanced Environmental Control System** 952ha (2.2%)

**Source:** Survey on Greenhouse Area, 2014, MAFF

* The area includes rain protection facilities.

**Plant factory:**
A plant factory is a cultivation facility capable of year-round, planned production of vegetables and others by means of sophisticated environmental control based on the monitoring of the environment and growth. (Report (April 2009) by a working group on plant factories in a research panel on agriculture- and commerce-industry cooperation)
2. Challenges of greenhouse horticulture (2) (management structure)

- The number of greenhouse horticultural farming households in Japan has been decreasing year after year due to the aging of farmers. But the area of greenhouses remains unchanged, at around 20a per household, and the scale of farming operations has failed to expand. The area of facilities erected therefore has decreased. In contrast, the area of greenhouses in the Netherlands has kept increasing year after year, so the scale of operation has been expanding.
- The area of greenhouses in Japan, seen on a scale-by-scale basis, is showing shrinking trends in operations smaller than 1ha but expanding trends in those larger than 1ha.

Number of farmers and operating land of greenhouse farm (Japan and the Netherlands)

<table>
<thead>
<tr>
<th>Operating land</th>
<th>Total greenhouse area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10a</td>
<td>3,488</td>
</tr>
<tr>
<td>10 ~ 30a</td>
<td>15,375</td>
</tr>
<tr>
<td>30 ~ 50a</td>
<td>11,578</td>
</tr>
<tr>
<td>50a ~ 1ha</td>
<td>9,762</td>
</tr>
<tr>
<td>10ha and more</td>
<td>4,880</td>
</tr>
<tr>
<td>Total</td>
<td>45,083</td>
</tr>
</tbody>
</table>

While the number of greenhouse horticultural farming households decreased, the management scales expanded, resulting in the maintenance of the area of greenhouses.

The number of greenhouse horticultural farming households decreased while the scale of operations leveled off, resulting in a decrease in the area of greenhouses.

Source: Census of Agriculture and Forestry, MAFF, Centraal Bureau voor de Statistiek
2. Challenges of greenhouse horticulture (3) (energy costs)

- Greenhouse horticulture is a business sector which, like the fishing sector, tends to be greatly affected by steep rises in fuel prices as heat, light and power expenses account for an extremely large portion of management cost.
- Fuel has been repeating wild price fluctuations, affected by geopolitical risks, foreign exchange rates and international commodity prices. It is a production material for which the prediction of future prices is difficult.

### Comparison of farm management expenses between greenhouse horticulture and paddy farming

<table>
<thead>
<tr>
<th></th>
<th>Management cost</th>
<th>Gross profit</th>
<th>Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse horticulture farming</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greenhouse green bell peppers</td>
<td>2,846</td>
<td>5,536</td>
<td>2,690</td>
</tr>
<tr>
<td>Greenhouse tomatoes</td>
<td>1,876</td>
<td>3,078</td>
<td>1,202</td>
</tr>
<tr>
<td>Greenhouse roses</td>
<td>2,077</td>
<td>2,664</td>
<td>586</td>
</tr>
<tr>
<td>Paddy farming</td>
<td>86</td>
<td>113</td>
<td>27</td>
</tr>
</tbody>
</table>

(Unit: 1,000 yen/10a)

Source: Statistied Survey on Farm Management and Economy by farming type, 2016, MAFF

### Ratio of heat, light and power expenses to farm management cost

<table>
<thead>
<tr>
<th></th>
<th>Greenhouse green bell peppers</th>
<th>Greenhouse tomatoes</th>
<th>Greenhouse roses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse horticulture farming</td>
<td>23%</td>
<td>14%</td>
<td>37%</td>
</tr>
<tr>
<td>Open field farming</td>
<td>Green bell peppers grown in an open field</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Cultivation of fruits</td>
<td>Mandarin orange grown in an open field</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Paddy field farming</td>
<td>Cultivation of rice</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Fishery</td>
<td>Squid fishing (coastal)</td>
<td>26%</td>
<td></td>
</tr>
</tbody>
</table>

Source: Statistied Survey on Farm Management and Economy by farming type, 2016 and fiscal 2015 survey report on fishery management, 2015, MAFF

### Price changes of type-A fuel oil for agricultural use

- **¥126/liter (August 2008)**
- **¥63.7/liter (May 2009)**
- **¥81.5/liter (January 2018)**

Reference: Statistics on agricultural prices

### Average price of type-A fuel oil during warming period in greenhouse horticulture

- 2006: 65.9 yen/liter
- 2007: 70.7 yen/liter
- 2008: 89.2 yen/liter
- 2009: 72.9 yen/liter
- 2010: 71.3 yen/liter
- 2011: 80.4 yen/liter
- 2012: 88.3 yen/liter
- 2013: 93.7 yen/liter
- 2014: 102.5 yen/liter
- 2015: 89.0 yen/liter
- 2016: 66.5 yen/liter
- 2017: 71.2 yen/liter

Reference: Statistics on agricultural prices