Situation of Greenhouse Horticulture

February 2018

Ministry of Agriculture, Forestry and Fisheries

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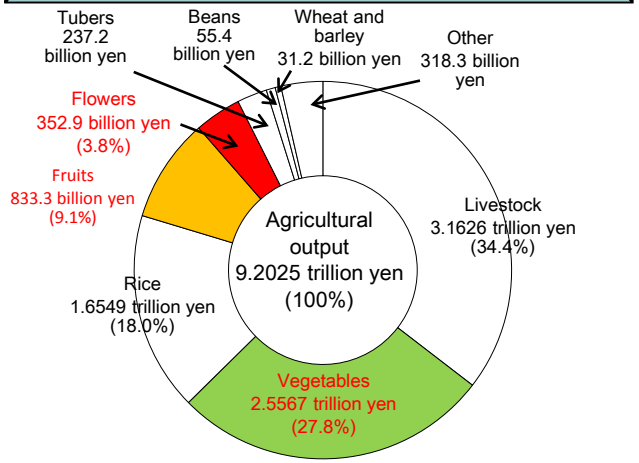
1. Status of greenhouse horticulture (1)

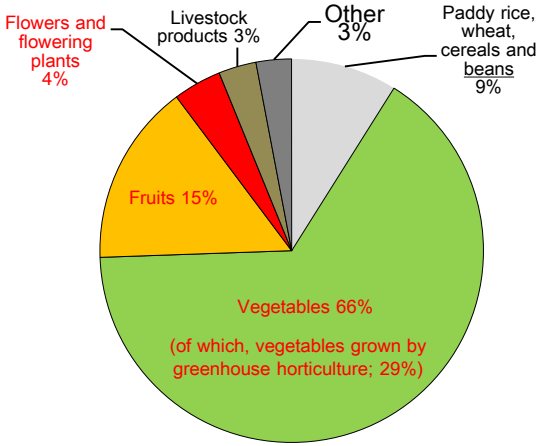
- Horticultural crops, such as vegetables, fruits and flowers, account for some 40% of Japan's agricultural production in value. As they have a strong potential to become high value-added products through growers' ingenuity, they form an important and attractive field chosen by 85% of new farmers.
-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



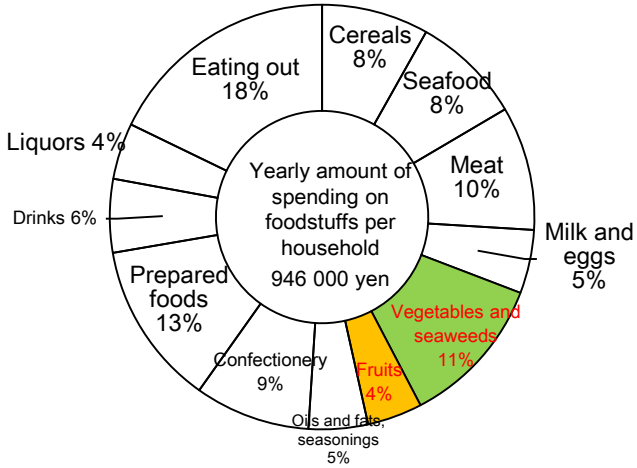
Source: Statistics of Agricultural Income Produced 2016, MAFF

○Item for new entry farmers



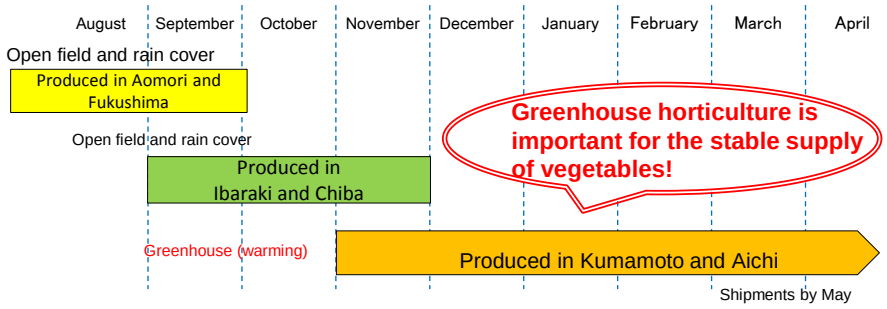
Source: Investigation of the Actual Farm Working of New Farmer 2016, National New Farmer Center for Becoming New Farmer

○ Yearly amount of spending on foodstuffs per household

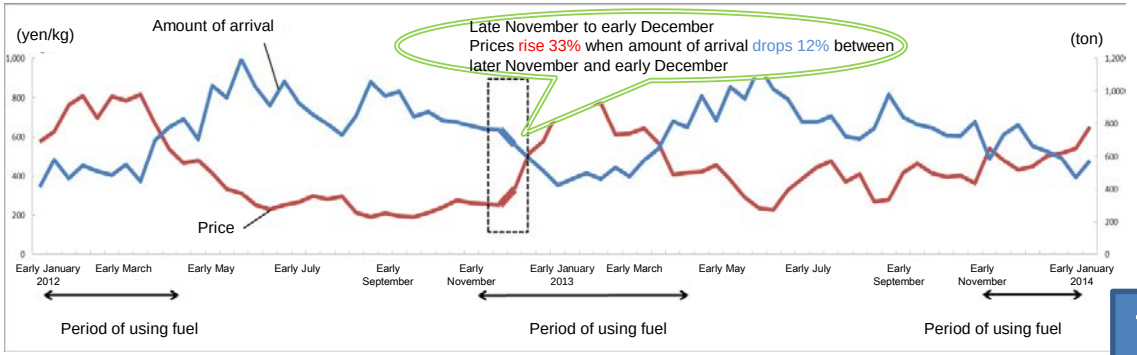


Source: Family Income and Expenditure Survey (2017) by the Ministry of Internal Affairs and Communications

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



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



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.

○Total area of greenhouse and share of production

Product	Protected cultivation Gross area (ha)	Share of production (%)
Tomatoes	6,971	74
Spinach	4,325	24
Strawberries	3,970	88
Cucumbers	3,525	61

Source:

Greenhouse Establishment, 2014, Vegetable Production Shipment Statistics , 2014 MAFF

○ Income per 10a of greenhouse horticulture

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

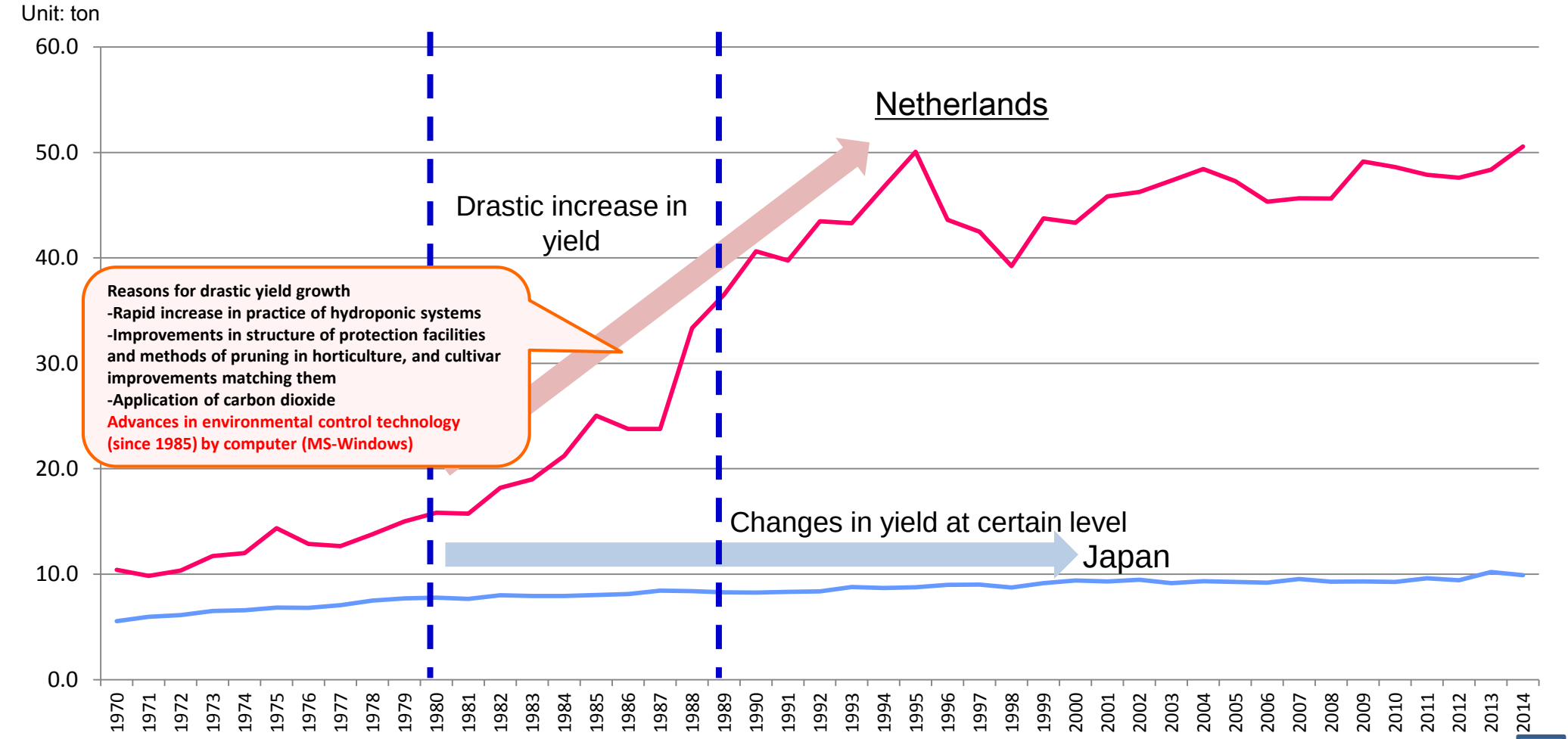
Source:

Statistics on Management by Farming Type, 2014 MAFF

2. Challenges to greenhouse horticulture (1) (environmental control (1))

○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 CO_2 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.

Changes in yield of tomatoes per 10a

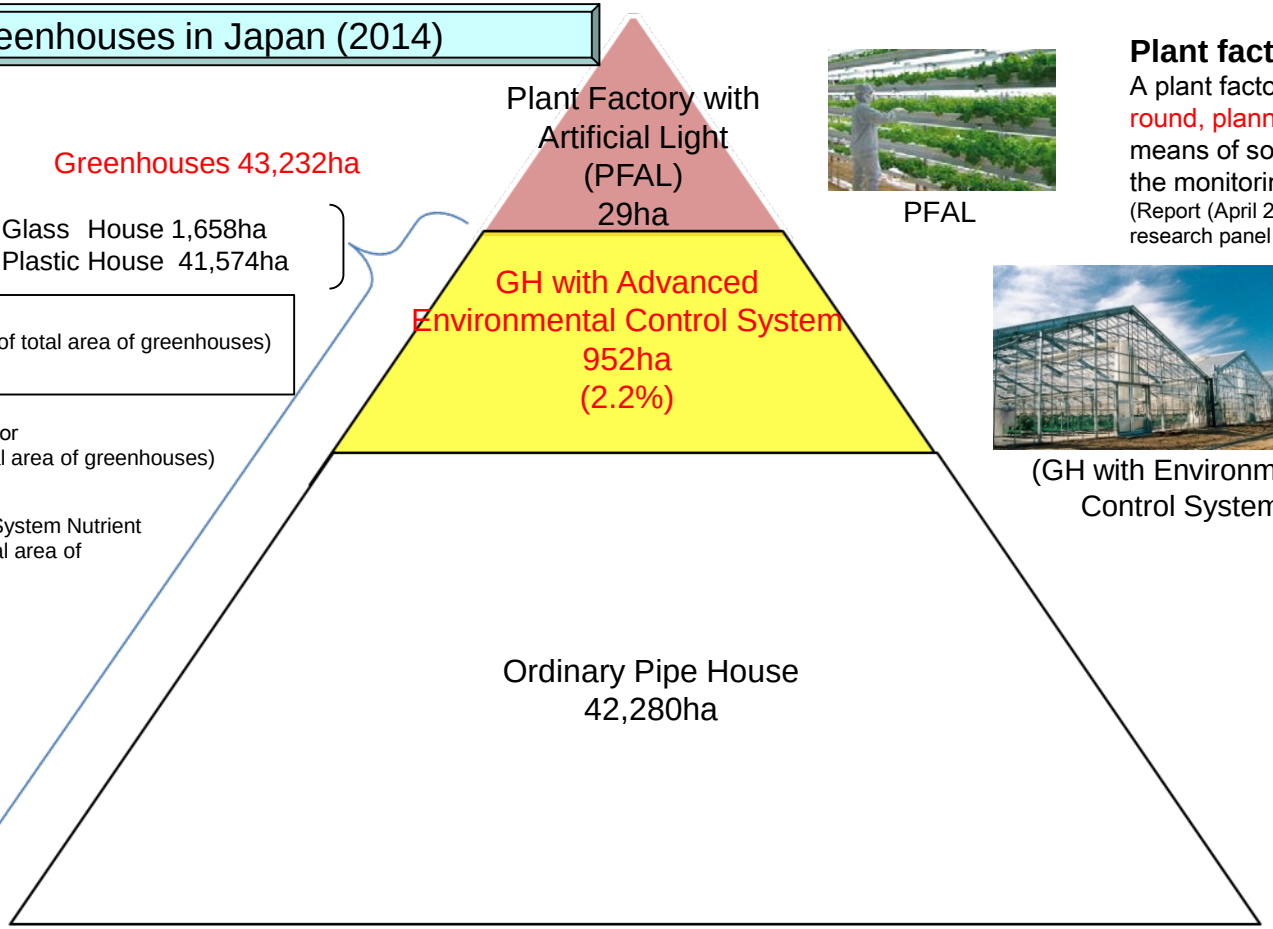


Sources: The Netherlands: FAOSTAT, Japan: Vegetable production shipment statistics (winter-spring tomatoes)

2. Challenges of greenhouse horticulture (1) (environmental control (2))

- 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)



PFAL

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)

(GH with Environmental Control System)


(Ordinary Pipe House)

Source: Survey on Greenhouse Area, 2014, MAFF
The area includes rain protection facilities.
* Area of a greenhouse includes rain covers.

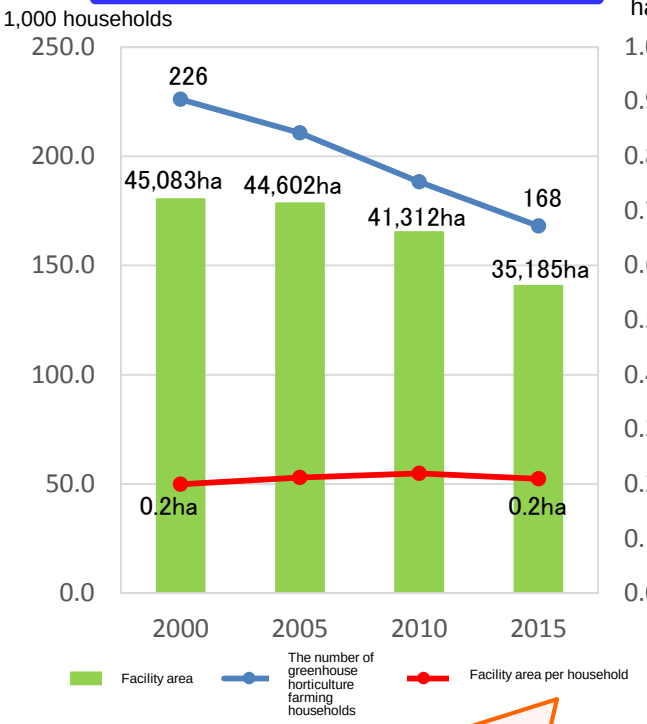
Area of PFAL (29 ha) was estimated based on National Survey on Plant Factory, March 2017.

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.

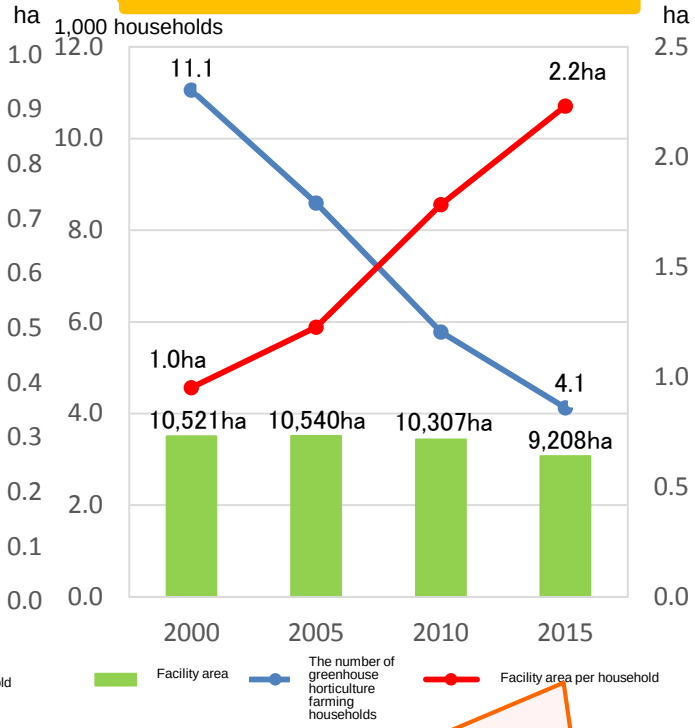
○ Number of farmers and operating land of greenhouse farm (Japan and the Netherlands)

Changes in Japan



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

オランダの推移



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

○Change of total area by size operating land (Japan)

Operating land	Total greenhouse area (ha)			
	2000	2005	2010	2015
Less than 10a	3,488	2,707	2,249	2,207
10 ~ 30a	15,375	13,853	11,977	9,754
30 ~ 50a	11,578	11,822	10,692	8,564
50a ~ 1ha	9,762	10,807	10,479	8,743
10ha and more	4,880	5,413	**5,915 (14% of all farming households)**	**5,917 (17% of all farming households)**
Total	45,083	44,602	41,312	35,185

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

(Unit: 1,000 yen/10a)

	Management cost	Gross profit	Income
Greenhouse green bell peppers	2,846	5,536	2,690
Greenhouse tomatoes	1,876	3,078	1,202
Greenhouse roses	2,077	2,664	586
Paddy farming	86	113	27

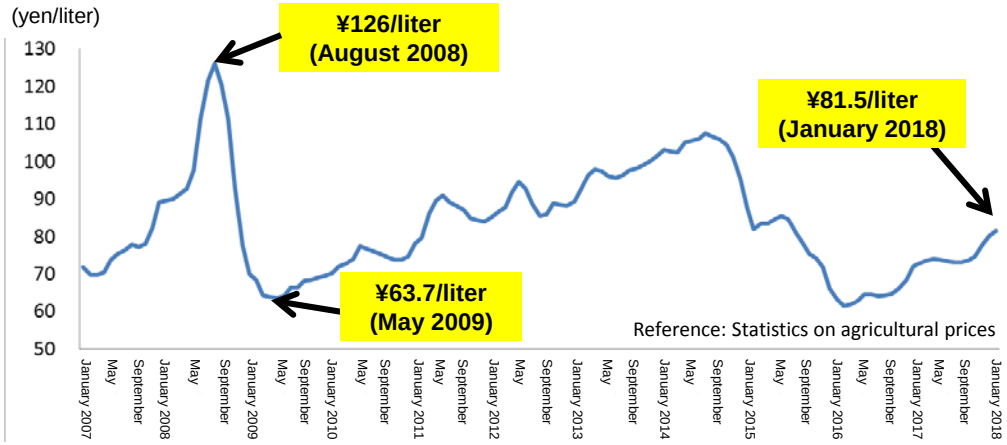
Source: Statistied Survey on Farm Management and Economy by farming type,2016,MAFF

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

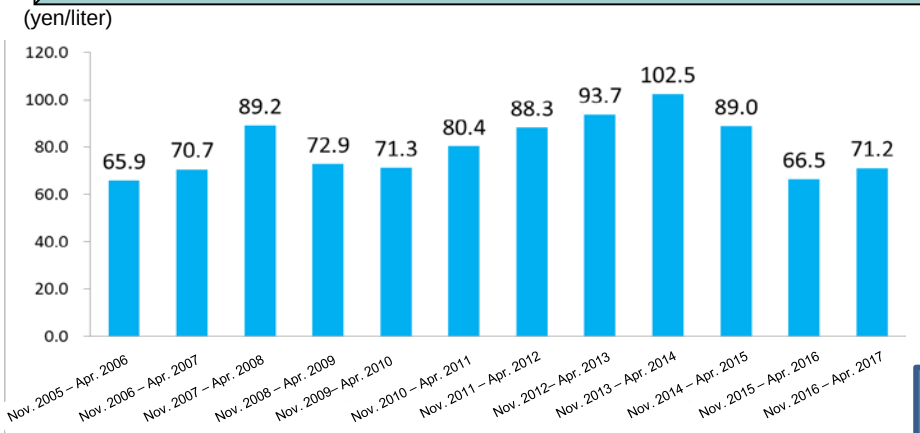
Greenhouse horticultural farming	Greenhouse green bell peppers	23%
	Greenhouse tomatoes	14%
	Greenhouse roses	37%
Open field farming	Green bell peppers grown in an open field	4%
Cultivation of fruits	Mandarin orange grown in an open field	5%
Paddy field farming	Cultivation of rice	5%
Fishery	Squid fishing (coastal)	26%

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



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



3. Tackling the challenges of greenhouse horticulture (approach for the next-generation greenhouse horticulture)

To pursue the establishment of a top-runner model (next-generation greenhouse horticulture) capable of overcoming the challenges facing Japan's greenhouse horticulture all together in the form of matching the nation's natural conditions by (1) installing advanced environmental control, (2) expanding the scale of operation through the utilization of employment, and (3) making use of regional energy, taking clues from greenhouse horticulture in the Netherlands.

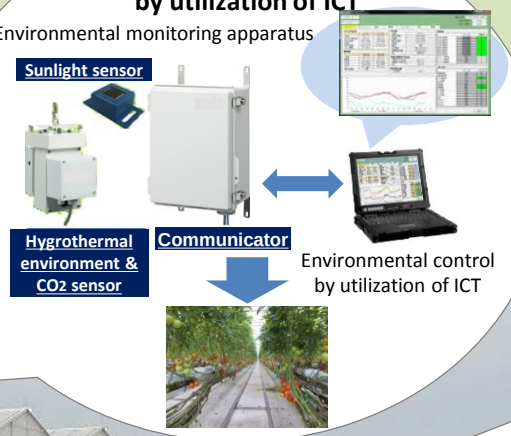
1. Productivity improvement by install of advanced environmental control technology

Realize the year-round production based on the sales plan with the grater yield by the horticulture in the weather-resistant Greenhouse with an environmental control system which is able to control different environments at the same time by utilizing ICT.

(Example) Success in yielding 30-40t/10a of large tomatoes(National average of 10t/10a)

Control temperature, CO_2, solar irradiance, etc. at the same time by utilization of ICT

Environmental monitoring apparatus



3. Reduction of dependence on fossil fuels by utilization of local energy resources

Realize the stable management of farms by the reduction of dependence on fossil fuels where price rise has a potent influence on farm management due to the fuel expenses account for big portion in the farming costs.

Utilization of local energy resources

2. Large-scale management utilizing employed labor

Realization of efficient production and expansion of management scale by utilizing employed labor through preparation and review of appropriate work plans, due assignment of employees, standardization of work processes, etc.

Employment-oriented production management needed for expansion of operation scale

Reference: Differences in natural conditions between Japan and the Netherlands

	Japan	The Netherlands
Temperature	Hot and humid in summer	Cool in summer
Accumulation of snow	Present	Almost non-existent
Big wind	Occasional brunt of typhoons	Absence of hurricane brunt
Main fuel	Fuel oil reliant on imports	Natural gas from North Sea oil field

3. Tackling the challenges of greenhouse horticulture (development of base of next-generation greenhouse horticulture)

- ○ Formation of ten model bases across Japan to create next-generation greenhouse horticulture matching natural conditions, etc. of the country extended north and south
- ○ To rotate the PDCA cycle by collecting the environment, growth, work and other data at the model bases and assess yield per 10a, the rates of reduction in the use of fossil fuel and productivity per worker in order to study integrant technologies for next-generation greenhouse horticulture.
- ○ To accumulate evidence that can help overcome the challenges facing Japan's greenhouse horticulture and improve profitability

Data to be collected at model bases

Daily program

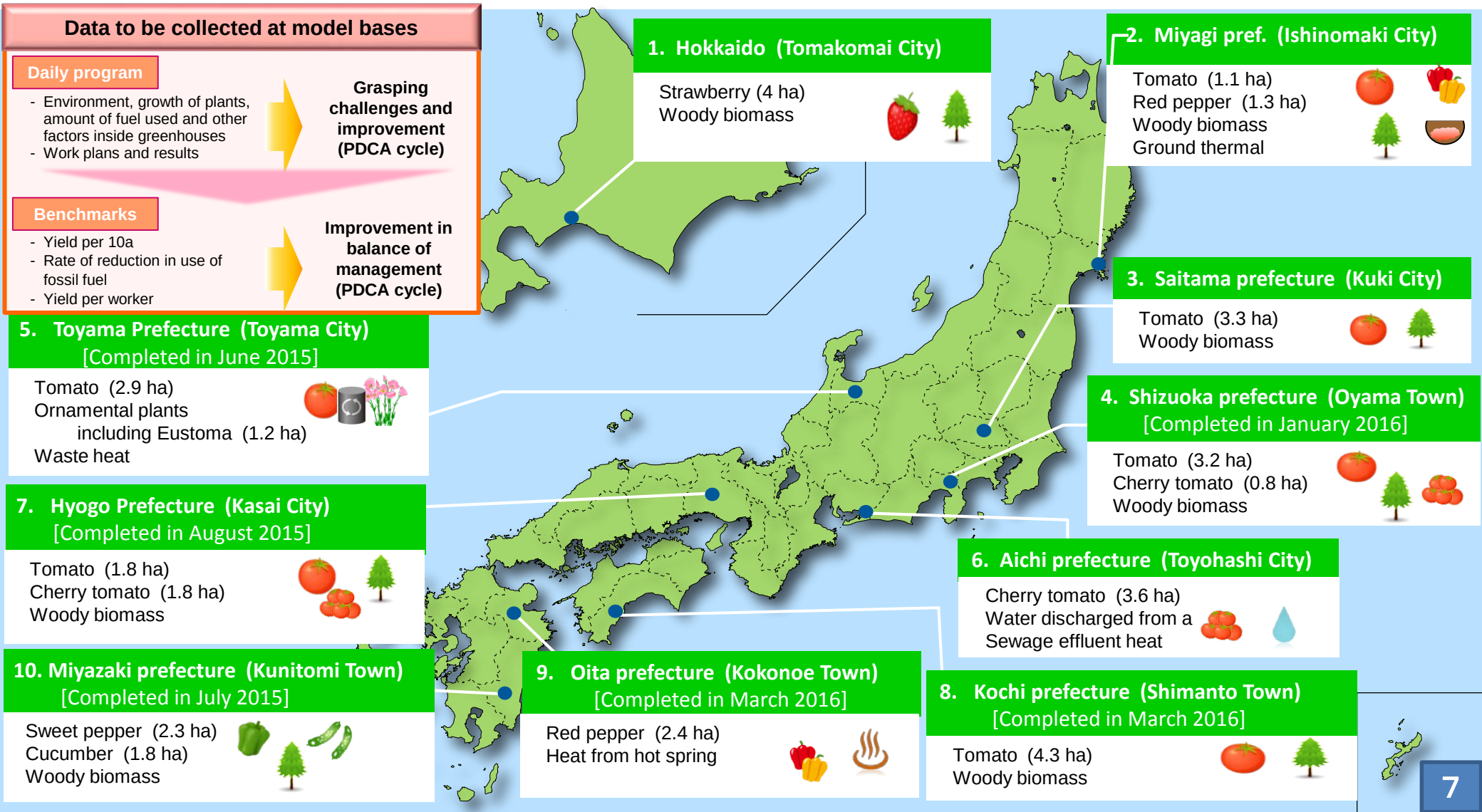
- Environment, growth of plants, amount of fuel used and other factors inside greenhouses
- Work plans and results

→ **Grasping challenges and improvement (PDCA cycle)**

Benchmarks

- Yield per 10a
- Rate of reduction in use of fossil fuel
- Yield per worker

→ **Improvement in balance of management (PDCA cycle)**



1. Hokkaido (Tomakomai City)

Strawberry (4 ha)
Woody biomass

2. Miyagi pref. (Ishinomaki City)

Tomato (1.1 ha)
Red pepper (1.3 ha)
Woody biomass
Ground thermal

3. Saitama prefecture (Kuki City)

Tomato (3.3 ha)
Woody biomass

4. Shizuoka prefecture (Oyama Town) [Completed in January 2016]

Tomato (3.2 ha)
Cherry tomato (0.8 ha)
Woody biomass

5. Toyama Prefecture (Toyama City) [Completed in June 2015]

Tomato (2.9 ha)
Ornamental plants including Eustoma (1.2 ha)
Waste heat

6. Aichi prefecture (Toyohashi City)

Cherry tomato (3.6 ha)
Water discharged from a Sewage effluent heat

7. Hyogo Prefecture (Kasai City) [Completed in August 2015]

Tomato (1.8 ha)
Cherry tomato (1.8 ha)
Woody biomass

8. Kochi prefecture (Shimanto Town) [Completed in March 2016]

Tomato (4.3 ha)
Woody biomass

9. Oita prefecture (Kokonoe Town) [Completed in March 2016]

Red pepper (2.4 ha)
Heat from hot spring

10. Miyazaki prefecture (Kunitomi Town) [Completed in July 2015]

Sweet pepper (2.3 ha)
Cucumber (1.8 ha)
Woody biomass

Hokkaido (Tomakomai City)

Strawberries　Wooden biomass

- To realize year-round production of strawberry with cool weather of summer in the north area of Japan.
- To introduce the advanced environmental control technology and make toward high quality and low cost production of strawberry.

Stock photos used

Venlo greenhouses

Year-round cultivation of strawberries in cold area

woody biomass

Names of consortium and its members

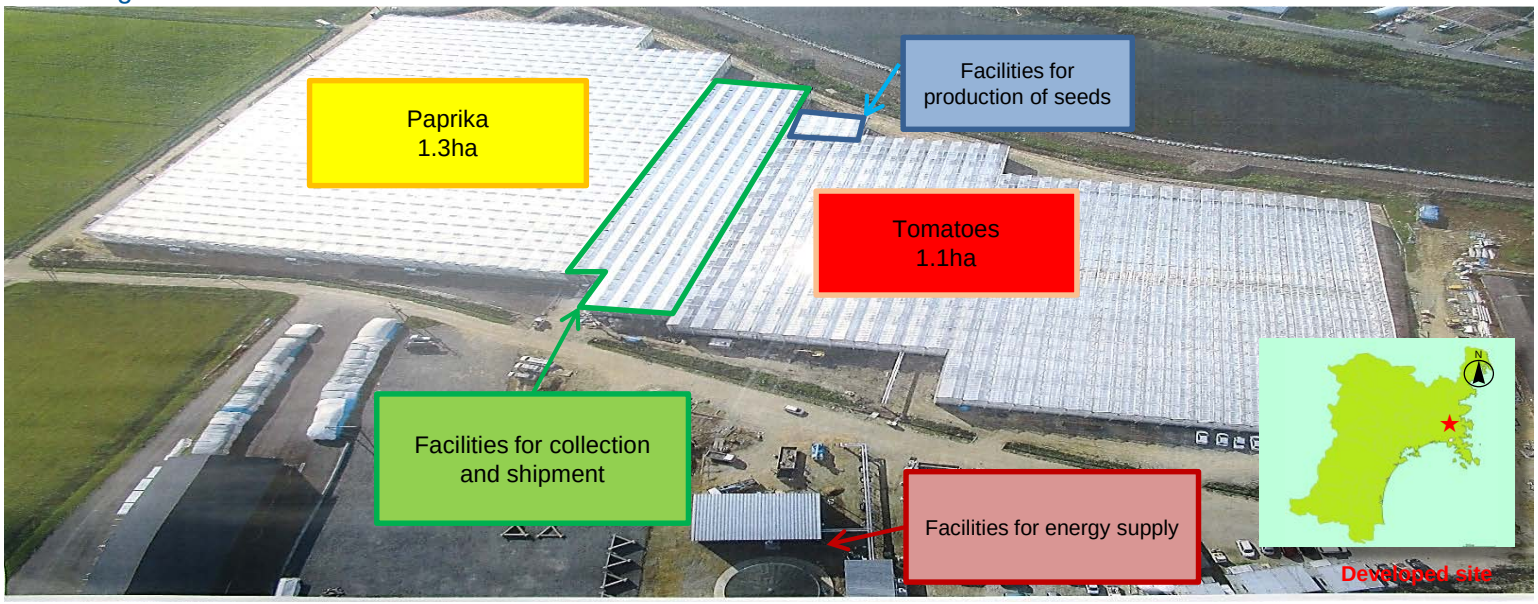
Name	Consortium of the Next-Generation type of Greenhouse Horticulture in Hokkaido
Members	Tomatoh Farm Co.,Ltd. / morimoto Co.,Ltd. / The Hokkaido Confectionery Association /Tomatoh Inc. / TANJI FORESTRY Co.,Ltd. / Tomakomai-Kouiki Japan Agricultural Cooperatives /Hokkaido Food Industry Promotion Organization / Hokkaido Government / Tomakomai City

Crops	Area	Yield (goal)
Strawberries	4ha	314t (7.5t/10a)

Category	Overview of project
Facilities at base	(1) greenhouses, (2) woody biomass, (3) facilities for production of seedling, and (4) facilities for collection and shipment
Technological demonstration	Demonstration of devices for warming inside and around a bench ,mist cooling, application of CO2, etc. adopting advanced environmental control technology
Other programs	(1) Establishment of regional brands for new products (2) expansion of overseas sales, etc.

Miyagi Prefecture (Ishinomaki City)

- Accelerate of re-establish farming with the Next-Generation of Greenhouse.
- To introduce advanced cultivation techniques of the Netherland and applies local energy source such as woody biomass and ground thermal.




Venlo greenhouse


Facilities for tomato cultivation


Facilities for paprika cultivation

Names of consortium and its members

Name	Consortium of the Next-Generation type of Greenhouse Horticulture in Ishinomaki
Members	Miyagi Prefecture / Ishinomaki City / De Liefde KITAKAMI Co.,Ltd. / Richfield Co.,Ltd. / DELICA FOODS HOLDINGS CO., LTD./ Ishinomaki seika Co., Ltd. / Mirai-saien.Co., Ltd./ JA Ishinomaki

Crops	Area	Yield (goal)
Tomatoes	1.1ha	370t (34t/10a)
Paprika	1.3ha	260t (20t/10a)

Category	Overview of project
Facilities at base	(1) greenhouse (2) facilities for wooden biomass and supply of geothermal heat, (3) facilities for seed production (4) facilities for collection and shipment
Technological demonstration	Demonstration of cooling and warming by means of woody biomass and geothermal heat pump, application of CO2 using LPG and other technologies
Other programs	Establishment of regional brands for new products, etc.

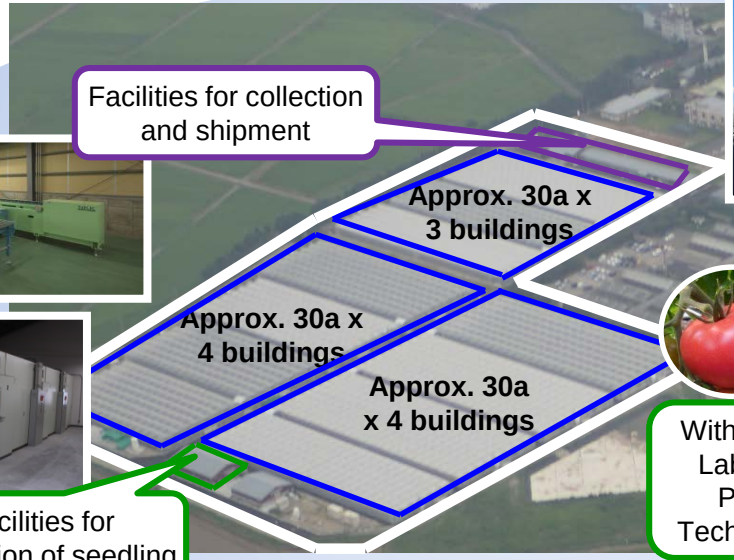
Saitama Prefecture (Kuki City)

Tomatoes

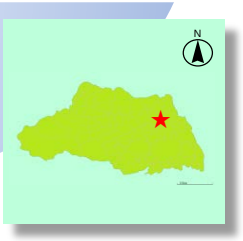
Wooden biomass

- To Aim at harvest unit crop 30 tons per 10a with a method for low height ,high density cultivation of tomato.
- Large scale introducing on "a system of integrated environmental control" with the ICT(information and communication technology).

Saitama Prefecture's mascots "Kobaton" & "Saitamacchi"



Within the Kuki Experimental Laboratory of the Saitama Prefectural Agricultural Technology Research Center



Developed site

Low-stage, high-density planting

Cut in fossil fuel (wooden pellets)

Sale at mass merchandise stores

Names of consortium and its members

Name	Consortium of the Next-Generation type of Greenhouse Horticulture in Saitama
Members	Saitama Prefecture / Kuki City / Aeon Agri Create Co., Ltd. / Aeon Retail Co., Ltd. /Saitama Prefecture Headquarters National Federation of Agricultural Cooperative Associations / Saitama Next-Generation Greenhouse Horticulture Tomato Study Group

Crops	Area	Yield (goal)
Tomatoes	3.3ha	990t (30t/10a)

Category	Overview of project
Facilities at base	(1) greenhouses, (2) wooden biomass boiler, (3) facilities for production of seedling, (4) facilities for collection and shipment Technological demonstrations
Technological demonstration	Introduction of an integrated environmental control system into low-stage, high-density planting to cut production cost, and implementation of large-scale demonstration tests utilizing ICT.
Other programs	Popularization and education of planting technology making full use of integrated environmental control technology, etc., and others.

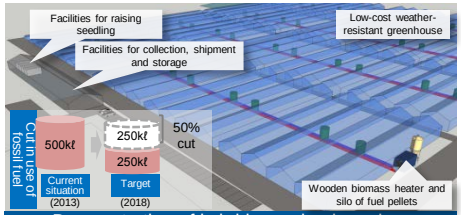
Shizuoka Prefecture (Oyama Town)


Tomatoes


Cherry tomatoes


Wooden biomass

- Using geographical advantages such as abundant biomass,sunlight,transportation infrastructure, to product high sugar content tomatoes by year-round cultivate and to create year-round employment.
- To improve productivity by environmental control system using ICT and promote branding by formulating marketing strategy.



Demonstration of hybrid warming based on wooden biomass and fuel oil


Low-stage, high-density planting


Factory of wooden pellets

High-sugar tomatoes

Names of consortium and its members

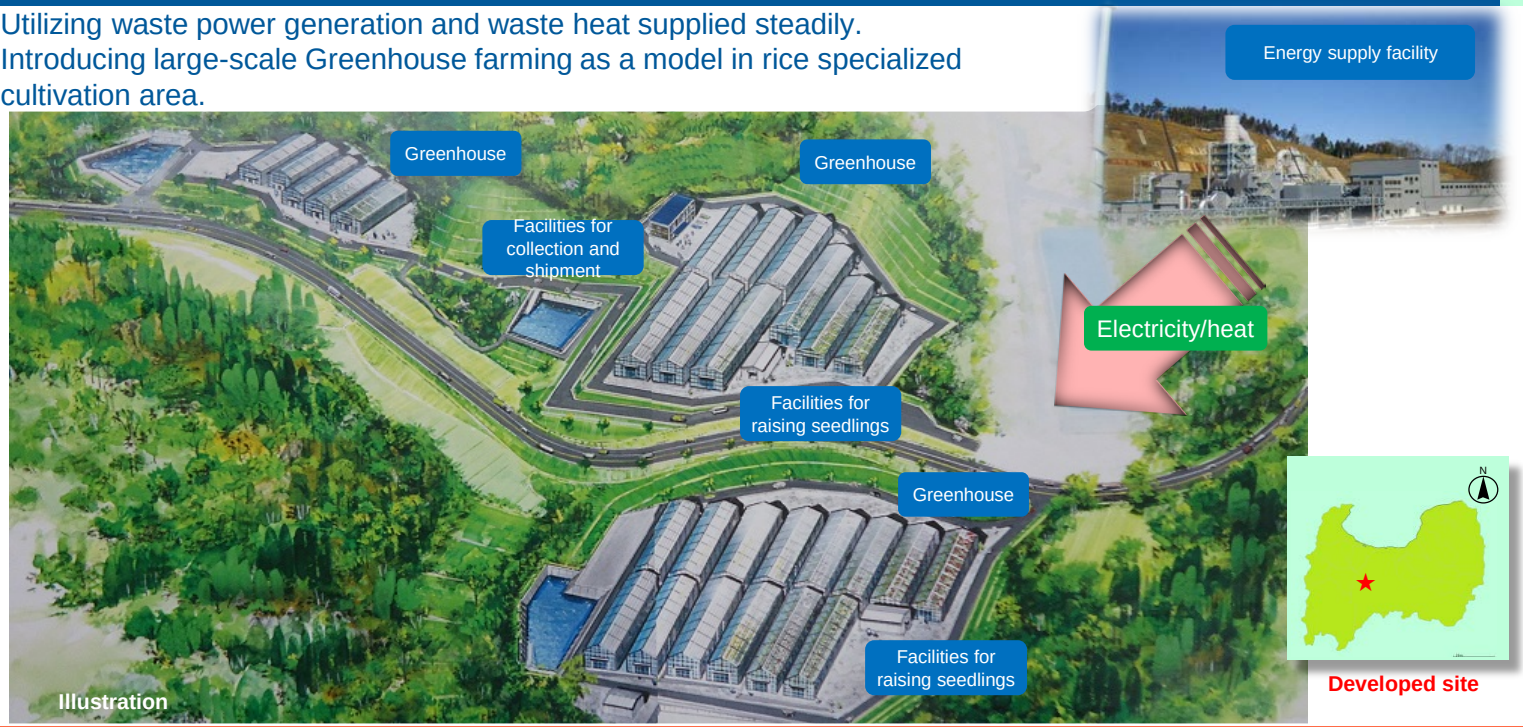
Name	Consortium of the Next-Generation type of Greenhouse Horticulture in Fujioyama
Members	SUNFARM FUJIOYAMA Co.,Ltd. / SEIWA Co.,Ltd. / NEPON Inc. / FUJISOGYO Co.,Ltd. / Shizutetsu store Co.,Ltd. / Tokyo Seika Co., Ltd. / JA Shizuoka Keizairen Co., Ltd. / JA Oigawa / University of Shizuoka / Shizuoka Prefectural Research Institute of Agriculture and Forestry / Shizuoka Prefecture Government / Shizuoka Tobu Regional Office of Agriculture and Forestry / Oyama Town Office

Crops	Area	Yield (goal)
High-sugar tomatoes	3.2ha	225t (7.0t/10a)
High-sugar cherry tomatoes	0.8ha	24t (3.0t/10a)

Category	Overview of project
Facilities at base	(1) greenhouses, (2) wooden biomass boiler, (3) facilities for production of seedlings, (4) facilities for collection and shipment
Technological demonstration	(Production cost cutting) Establishment of hybrid technology in combination with fuel oil to maximize the use of wooden biomass (ICT, advanced environmental control) Establishment of technology to maximize photosynthesis and increase profitability. Studies on streamlining of production and labor management by ICT
Other programs	Formulation of marketing strategy by prefectural university and users

Toyama Prefecture (Toyama City)

- Utilizing waste power generation and waste heat supplied steadily.
- Introducing large-scale Greenhouse farming as a model in rice specialized cultivation area.



Developed site

Supply of waste heat from industrial waste disposal facilities to greenhouse by heat storage container

Cultivation of tomatoes with high sugar content by minimizing water, fertilizer and agricultural chemicals.

Cultivation of showy prairie gentian and other flowers

Names of consortium and its members

Name	Consortium of the Next-Generation type of Greenhouse Horticulture in Toyama
Members	Toyama Kankyo Seibi Co.,Ltd. / Japan Agricultural Cooperatives Aoba /Agricultural union corporation Wagouen / Smart Forest Co.,Ltd. / NTT DATA INSTITUTE OF MANEGEMENT CONSULTING,Inc / ATGREEN Co.,Ltd / Toyama Prefecture / Toyama Agriculture and Forestry Promotion Center / Toyama City

Crops	Area	Yield (goal)
Fruit tomatoes	2.9ha	505t (17.7t/10a)
Flowers (showy prairie gentian, etc.)	1.2ha	1.43million

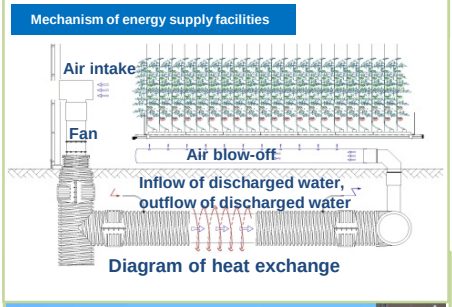
Category	Overview of project
Facilities at base	(1) greenhouse (2) heat and electricity cogeneration system from boiler equipped with power source using fuel via waste (3) facilities for production of seedlings
Technological demonstration	(1) Demonstration to introduce an advanced environmental control system utilizing ICT (2) Demonstration of wearable devices, etc. to share knowledge processed into data
Other programs	(1) Development of new sales routes (including exports) (2) Study sessions for cultivation technology (creation of regional jobs and nurturing of human resources) (3) Grasping needs among consumers and users

Aichi Prefecture (Toyohashi City)

Cherry tomatoes

Sewage treatment plant
Heat from treated water

- Realization of stable production of cherry tomato yield up to 21t/10a with air-conditioning and environmental control in root area.
- Reduce fossil fuel usage by more than 30% with utilizing heat energy from discharged water out of from sewage treatment plants.



Venlo Greenhouse

Facilities for cultivation

Long-term multi-stage cultivation of cherry tomatoes

Names of consortium and its members

Name	Consortium of the Next-Generation type of Greenhouse Horticulture in Aichi Toyohashi
Members	Inochio Mirai Inc. / Inochio Tsunagu Inc. / IDEARU･ATORE Co.,Ltd. / Aspen Food Planning Co.,Ltd. /Kawamura Shoji Corporation / Inochio Agri Inc. / SCIENCE CREATE Co.,Ltd. /JA Toyohashi / JA Aichi-Keizairen / Toyohashi University of Technology / Aichi Prefecture /Toyohashi City

Crops	Area	Yield (goal)
Cherry tomatoes	3.6ha	726t (21t/10a)

Category	Overview of project
Facilities at base	(1) greenhouse (2) heat and electricity cogeneration system from boiler equipped with power source using fuel via waste (3) facilities for production of seedlings (4) facilities for collection and shipment
Technological demonstration	(1) Demonstration of high-quality and high-yield cultivation by compound environmental control (vapor-pressure deficit control by mist, supply of carbon dioxide, root zone environmental control, etc.) (2) Demonstration of warming technology utilizing heat energy from discharged water
Other programs	Establishment of regional brands and fostering of future horticulture farms by accepting training for successors of agriculture and new entrants into agriculture

Hyogo Prefecture (Kasai City)

Tomatoes | Cherry tomatoes | Wooden biomass

- Establishment of new agricultural business models with by introducing system of integrated environmental control ,etc.
- To realize year-round, stable, high yield and 4 fixed (fixed time, quantity, quality, price) production.
- Local production for local consumption of energy with local woody biomass.

Developed site

long-term cultivation

Wooden chip boiler

Facilities for collection and shipment

Over the counter sales

Names of consortium and its members

Name	Consortium of the Next-Generation type of Greenhouse Horticulture in Hyogo
Members	Hyogo Next Farm Co., Ltd. / Saladbowl Co., Ltd. / Higashibaba Farm Co., Ltd. /Jardin Co., Ltd. / Kansai Super Market Ltd. / Kobe University /JA Hyogomirai / Kasai City / Taka Town / Hyogo Midori Public Corporation /Hyogo Prefecture

Crops	Area	Yield (goal)
Tomatoes	1.8ha	630t(35t/10a)
Cherry tomatoes	1.8ha	360t(20t/10a)

Category	Overview of project
Facilities at base	(1) greenhouses, (2) wooden biomass boiler, (3) facilities for production of seedlings, (4) facilities for collection and shipment
Technological demonstration	(1) Integrated environmental control technology (application of CO_2, water supply control, etc.) (2) Application of CO_2 using combustion gas utilizing an LPG boiler
Other programs	(1) Nurturing of human resources with fulltime employment to learn know-how for facilities management (advanced cultivation technology, labor control, etc.) (2) Popularization and education of year-round cultivation technology utilizing integrated environmental control technology, etc.

Kochi Prefecture (Shimanto Town)

Tomatoes

Wooden biomass

- Reduce fossil fuel consumption with introducing large-sized woody biomass boiler using sawdust.
- Cooperate with the adjoining training center of prospective farmers to extent the results of the base to farmers.

Developed site

Venlo greenhouse

High-eave greenhouse (tomatoes)

Wooden biomass boiler

Names of consortium and its members

Name	Consortium of the Next-Generation type of Greenhouse Horticulture in Kochi
Members	Shimanto Mihara Farm Co.,Ltd. / Best Grow Co.,Ltd. / Shimanto Tomato Co.,Ltd. /Shimanto Blue sky Farm Co.,Ltd. / Akatsuki Industrial Co.,Ltd. / Shimantocho Forestry Association /JA Shimanto / Kochi Prefectural Federation of Horticultural Cooperative Associations / Faculty of Agriculture, Kochi University / Kochi University of Technology / Shimanto Town / Kochi Prefecture

Crops	Area	Yield (goal)
Tomatoes	4.3ha	1,651t (38.4t/10a)

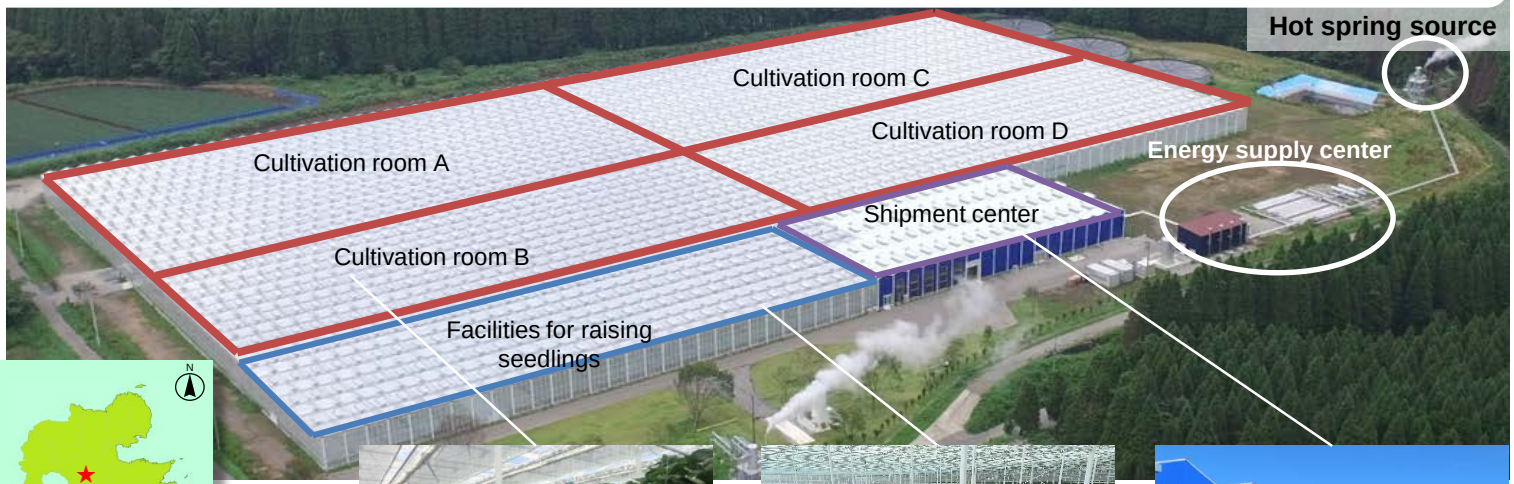
Category	Overview of project
Facilities at base	(1) greenhouses, (2) wooden biomass boiler, (3) facilities for production of seedlings, (4) facilities for collection and shipment
Technological demonstration	(1) Demonstration of high-quality, high-yield technology by compound environmental control (CO_2 generation device, fine mist device, etc.) (2) Demonstration of cultivation for reduction of production costs by utilization of aerial work platform and nutriculture cultivation device, etc.
Other programs	(1) Leaning of technologies through technological and management seminars, etc. (2) Stable shipments and sales matching needs among actual users, etc.

Oita Prefecture (Kokonoe Town)

Red/yellow bell peppers

Hot spring heat

- Practice of large-scale Greenhouse farming utilizing heat from hot spring as a regional energy.
- To supply domestic paprika stably in year-round with advanced environmental control technology.



Developed site

Utilization of geothermal energy

Venlo greenhouse

Cultivation of red/yellow bell peppers

Names of consortium and its members

Name	Consortium of the Next-Generation type of Greenhouse Horticulture in Oita
Members	Takahiko Agro-Business Co.,Ltd. / TAKAFUJI Co.,Ltd. / Kokonoe Town / Oita Prefecture /Shinsankyo Foods Distribution Center Co., Ltd. / Co-op oita / JA kusukokonoe

Crops	Area	Yield (goal)
Red/yellow Paprika	2.4ha	393t (16.3t/10a)

Category	Overview of project
Facilities at base	(1) greenhouse (2) hot spring heat supply center (supply of geothermal water via heat exchanger) (3) facilities for production of seedlings, (4) facilities for collection and shipment
Technological demonstration	(1) Advanced environmental control system (2) mist cooling (3) carbon dioxide application technology, etc.
Other programs	Development and expansion of sales routes and development of products to secure contract sales, etc.

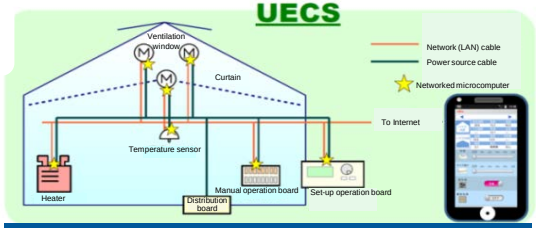
Miyazaki Prefecture (Kunitomi Town)


Cucumber


Green pepper


Wooden biomass

- To construct cultivation management system with high productivity utilizing advanced ICT technology.
- Extend to the region as a model for large-scale intensive farming by cooperating with JA's training system of prospective farmers.



Conceptual diagram of UECS


Wooden pellet heater


State of cucumber and green bell pepper production


Use of base as training venue

Names of consortium and its members

Name	Consortium of the Next-Generation type of Greenhouse Horticulture in Miyazaki
Members	Kyushu Olympia Kogyo / Suncool System / Fujitsu / JA Miyazaki Chuou /JA Farm Miyazaki Chuou / JA Miyazaki Chuou-Kai / JA Miyazaki Keizairen /Miyazaki Prefecture / Miyazaki City / Kunitomi Town / Miyazaki Agriculture Public Corporation

Crops	Area	Yield (goal)
Green pepper	2.3ha	345t (15t/10a)
Cucumber	1.8ha	450t (25t/10a)

Category	Overview of project
Facilities at base	(1) greenhouses, (2) wooden biomass boiler, (3) facilities for production of seedling, (4) facilities for collection and shipment
Technological demonstration	Introduction and demonstration of "integrated greenhouse horticulture production support system," centered on a ubiquitous environmental control system and combining (1) advanced high-yield cultivation technology, (2) cost reduction technology making effective use of a wooden biomass heater, etc. and (3) advanced production management system incorporating cultivation management records and growth data.
Other programs	Practice of environmental protection-oriented agriculture such as cultivation to utilize natural predators to cut use of agricultural chemicals

4. Expansion of programs for next-generation greenhouse horticulture (1) direction of promotion

○ As a basic direction, expansion of operations will be promoted while pushing ahead with the shift from greenhouse horticulture based on intuition and experience to environmental control-oriented horticulture.

○ To make greenhouse horticulture widely possible in a reproducible manner in places in addition to a base of greenhouse horticulture by analyzing and disseminating knowledge and know-how learned from the base. For core technologies such as advanced environmental control technology, which hold the key to solutions to challenges, demonstrations and training programs to learn about technologies matching local conditions will be promoted to expand programs for next-generation greenhouse horticulture.

○ Direction of promoting next-generation horticulture (diagram)

Practice of greenhouse horticulture to realize a stable supply and income increase!!

Model base

Next-Generation Type of GH

Year-round production by advanced environmental control
- Expansion of scale by hired labor and introduction of labor saving techniques
- Energy cost reduction by local energy sources

To develop knowledge from base and spread core technologies!!

GH with Environmental Control

- Carbon dioxide generator, nutrient cultivation system
- Cultivation method based on data obtained from GH environment.

Ordinary GH

- Mainly heater.
- Cultivation method based on farmers' experience and intuition.

Programs to stabilize management of greenhouse horticulture

- Cut in cost of erecting weather-resistant greenhouses
- Cut in use of fuel by energy saving

Cost reduction

Cost reduction

Overall process chart of next-generation greenhouse horticulture business

2013 supplementary budget | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021

(1) Development of base of next-generation greenhouse horticulture (model base)

Development of 10 model bases

The model bases in Shizuoka Pref., Toyama Pref., Hyogo Pref., Kochi Pref., Oita Pref., Miyazaki Pref. completed

The model bases in Hokkaido, Miyagi Pref., Saitama Pref., Aichi Pref. completed

Practice of sustainable greenhouse horticulture capable of overcoming three challenges

(2) Analysis and verification of know-how of base of next-generation greenhouse horticulture and dissemination of information

Support for establishment of model base and analysis of know-how

Dissemination of information on know-how of model base and discovery of new technology to nurture human resources

Spread of model base's knowledge in reproducible manner

(3) Learning of key technologies for next-generation greenhouse horticulture

Advanced environmental control technology, employment-oriented production control technology, labor-saving technology, etc.

Collaboration with other policy programs
(subsidy for creating strong agriculture, project to reinforce production areas, public financing for policy implementation, etc.

Introduction of advanced environmental control equipment, etc.

Promotion of advanced environmental control equipment, etc.

4. Expansion of programs for next-generation greenhouse horticulture (2) (budgetary measures (1))

○ As for advanced environmental control technology, employment-oriented production management technology, and labor-saving technology including automatization, etc., which hold the key to productivity improvement and expansion of operations in greenhouse horticulture, support was provided for the creation of a mechanism to learn technologies, etc. through such measures as demonstrations matching needs in production areas and acceptance of training at a demonstration greenhouse.

○ In addition, support was provided for the development of a demonstration greenhouse needed to erect next-generation, large-scale greenhouse horticulture facilities and for analysis, orderly disposition and information dissemination of next-generation greenhouse horticulture and ways of lowering installation costs.

1. Promotion of productivity improvement and scale expansion in greenhouse horticulture

Project to support expansion of scale in next-generation greenhouse horticulture (project to support learning about next-generation greenhouse horticulture technologies)

Establishment of mechanism to learn about technologies for improving productivity and accelerating expansion of operations

○ Implementation of technical demonstration, training, etc. by consortium

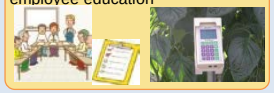
Members of consortium — Prefectural governments and producers are essential members

- Prefectural governments and municipal governments (administration, experiment and research institutes and promotion organs)
- Producers
- Actual users
- Producer organizations
- Makers of greenhouse horticulture equipment
- Farmland Banks

Technology demonstration and training

Advanced environmental control technology
Visualization and analysis of data and environmental control inside a greenhouse

Employment-oriented production management technology
Preparation of production and work plans, assignment of personnel and employee education



Labor saving technology
Automatization of work, etc. enable large area management by small number of people

○ Technological demonstration ○ Learning of technologies by acceptance of training at demonstration green house ○ Technological instructions ○ Preparation of manuals

Productivity improvement + Expansion of management scale

Consolidation of farmland and facilities
Focused support for consolidation of farmland and facilities via Farmland Banks, etc.

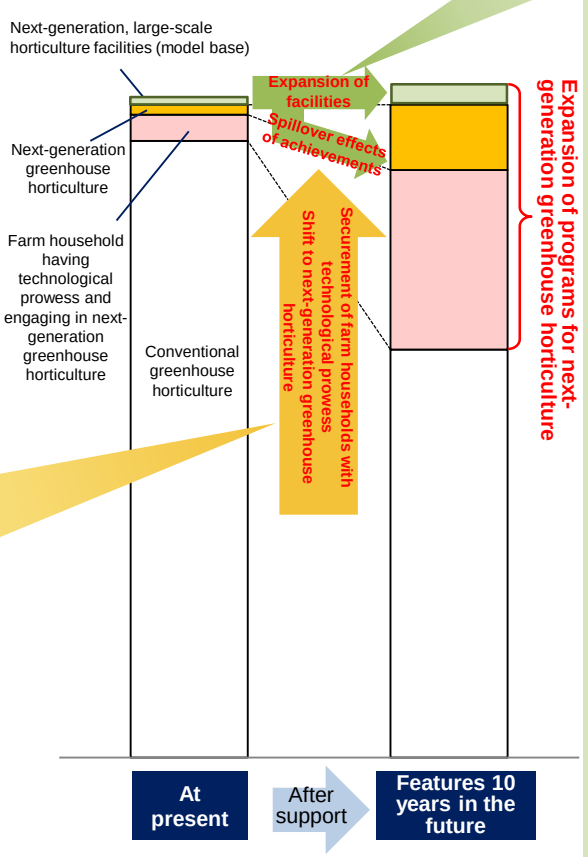
*In particular, preferential adoption in case of utilizing Farmland Banks

Greenhouse cost cutting
Support also for the development of a demonstration greenhouse, utilizing cost reduction technology

*Collaboration with a subsidy program to create strong agriculture

Dissemination of achievements of demonstrations to various regions by consortium

Diagram of expansion of programs for next-generation greenhouse horticulture



2. Promotion of next-generation greenhouse horticulture, etc.

Subsidy program to create strong agriculture (preferential quota for next-generation greenhouse horticulture)

○ Support for next-generation, large-scale horticulture facilities, combining advanced environmental control technology, utilization of local energy and utilization of energy-saving technology and for a development demonstration greenhouse needed to learn about technologies

Accumulation of facilities from production to shipment

Project to support expansion of scale in next-generation greenhouse horticulture (project for promoting the expansion of areas for next-generation greenhouse horticulture)

○ Support for preparation of a guidebook analyzing and sorting out know-how of model bases of next-generation greenhouse horticulture and ways of cutting installation costs and for hosting of nationwide forums, etc.

4. Expansion of programs for next-generation greenhouse horticulture (2) (Budgetary measures (2))

○ To promote a shift to a production technology system capable of accurate environmental control, based on the monitoring of environments and growth, as well as form production technology based on intuition and experience, support is provided for the introduction of low-cost, weather-resistant greenhouses, environment control equipment, etc. in projects covered by the subsidy program to create strong agriculture and the program to reinforce production areas.

○ Subsidy program to create strong agriculture

Subsidies provided for the following:

Development of core facilities, etc. in production areas

Facilities for collection, shipment and storage, facilities for processing of agricultural products, facilities for advancement of production technologies (low-cost, weather-resistant greenhouse, advanced environmental control horticulture facilities, etc.), improvement of small-scale land base, facilities to protect agricultural products from damage, etc.


Plant factory


Greenhouse equipped with compound environmental control equipment


Low-cost weather-resistant greenhouse

Subsidy rate :
Fixed amount for prefectures (no more than 1/2 of project cost for primary project undertakers)

Principal project undertakers :
Organizations, etc. formed by prefectures, municipalities and farmers

Destination of subsidies :
State - prefectures - primary project undertakers

○ Program to reinforce production areas

Subject to subsidies :

(1) Expenses to develop facilities and lease machinery and equipment, etc. needed to attempt a shift to production of highly profitable crops and cultivation system, based on plans to reinforce production areas, expenses needed for replanting, expenses to introduce materials, etc. needed at time of conversion, etc.
(2) Programs to promote effects of programs of (1) (Expenses needed for preparation of plans)


Environment control board


Control of temperature, solar irradiation and other environments


Heat pump

Subsidy rate:
No more than 1/2 for development of facilities, no more than 1/2 the price for leasing agricultural equipment, etc.

Principal project undertakers:
Farmers, farmers groups, etc. positioned in "plans to reinforce production areas" prepared by regional agriculture revitalization council, etc.

Destination of subsidies :
(Development projects) state - prefectures - principal project undertakers
(Funding projects) state - fund management organizations - prefectures - principal project undertakers

5. Expansion of programs for next-generation greenhouse horticulture (3) (Technological development)

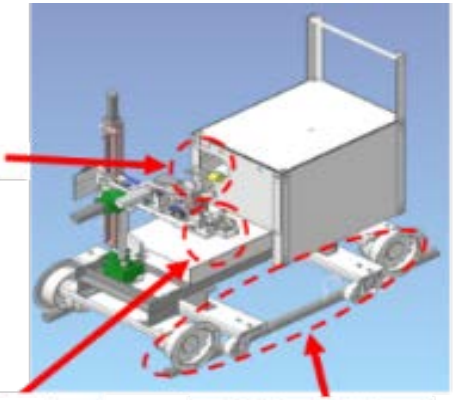
- New technological development, incorporating AI, robotics and others, is important for improving productivity in greenhouse horticulture and expanding operations.
- Programs to develop, among others, an image processing device enabling precise environmental control and growth prediction thanks to the development of tomato harvesting robots and visualization of photonic syntheses are underway.

Automatic Tomato Harvesting Robots

Harvesting has depended on manual work as each tomato needs to be picked without damaging it after confirming its harvesting period.

Amid the escalating labor shortage, the development of an automatic harvesting robot, which will work day and night, is underway to promote labor saving.

(2) Sensor unit



(1) Harvesting unit (3) Mobile unit

Utilization of AI in robots

Image recognition and functions to acquire proficiency in movements enable robots to recognize red tomatoes, etc., which are ready for harvest, and pick them without damaging them, in the same way that humans work, by repeating the acquisition of proficiency.

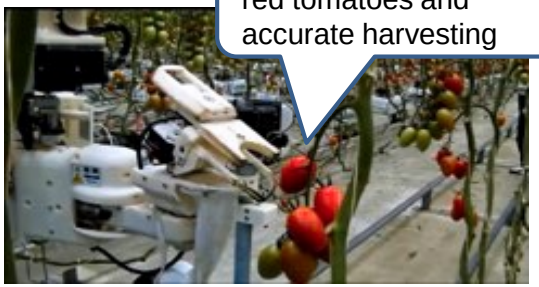
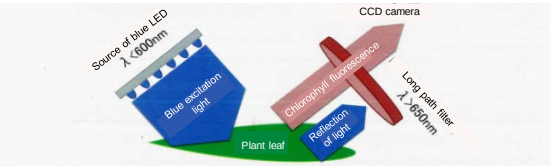


Image processing device for crops

Image measuring mechanism for chlorophyll fluorescence

- Chlorophyll fluorescence is measured at night as it is mixed with other light invisible during daytime.
- In measurement, a blue LED is shone on the plant and the blue light reflected by the leaves via a long path filter is eliminated before a CCD camera captures only chlorophyll fluorescence.
- The method is suitable for measuring plants before harvesting as it can measure photonic syntheses in a non-destructive and non-contact manner



Measuring part Source of blue LED CCD camera

Visualization of plant's photonic synthesis and analysis of relativity with growth environments

(Reference) Technologies put to practical use to date

○Addressing high temperatures and typhoons in summer and snow is an important challenge facing greenhouse horticulture in Japan, in comparison with the Netherlands. Various studies have generated new technologies useful in work sites.

○While the Netherlands has been going ahead in environmental control systems, Japan has developed products with upgraded functions thanks to aggressive entry from other sectors, based on high-level technological prowess.

○ Measures to address high temperatures in summer

Development of materials that make environmental control possible in summer when the amount of insolation is large and the temperature and humidity are high, in order to practice greenhouse horticulture all year round.

Mist cooling

Lowering temperatures without moistening crops and at low cost has become possible by improving the shape of nozzles to spray misty water and spraying pressure.

Efficient vaporization by cyclical fan and fine mist nozzle

Heat pump

Application of Japanese home-use air conditioning technology, highly efficient by global standards, to agriculture. In addition to cooling and dehumidification, an air conditioner, combined with a boiler in winter, is expected to generate energy-saving effects.

○ Measures to address typhoon and heavy snowfall

Development of a greenhouse that can be erected at lower cost than a conventional greenhouse built with reinforcing bars, and a highly durable covering material that maintains strong resistance to typhoons and snowfall

Low-cost weather-resistant greenhouse

Utilization of thin but strong steel material fostered in the automobile industry. Securement of durability by reinforcing pillars and foundation

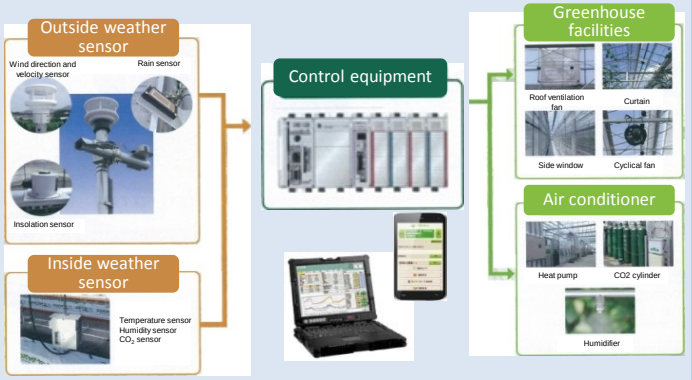
Covering materials for greenhouse

PO film
Lighter and more durable than vinyl and replacement is unnecessary for 5 years (2-3 years in case of vinyl)

Fluorine film
As sunlight-permeable as glass and highly durable. Long-term use of more than 10 years possible.

○ Environmental control system

System for environmental control in response to multiple environmental conditions that include not only temperature but also humidity, CO2 and amount of insolation. While Dutch and other overseas makers had been ahead, efforts to improve functions have been underway in Japan in recent years due to electronics makers' active entry.



Various sensors and monitoring equipment to measure environmental data

Visualization of environmental data facilitates improvements from cultivation based on intuition and experiences, making comparisons with outstanding farmers' skills.

Sensor box

5. Support for individual challenges (1) fuel price [1]

○ Preparation of plans for promoting energy-saving and other measures to promote the shift to management resistant to the effects of sharp fuel price rises, under which compensation is provided to production areas striving to cut the use of fuel by more than 15% if fuel prices rise by a set standard (115% of average of prices in five of the past seven years)

In addition, (1) special low temperature measure to lower the trigger benchmark price when the monthly temperature falls below the average-year temperature and (2) special soaring price measure that is implemented in the case of a rise of more than 20% from the previous year's average price.

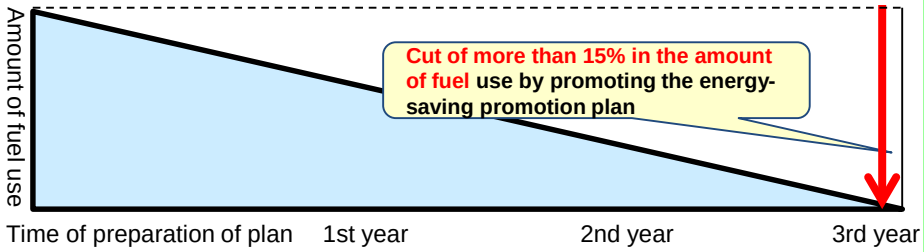
Basic approaches to address steep fuel price rises

Shift management resistant to steep fuel price rises

○ Preparation of plans to promote energy-saving and other measures to create a safety net in production areas striving to cut more than 15% in the use of fuel to stabilize management by easing effects of steep fuel price rises that cannot covered by energy-saving efforts alone.

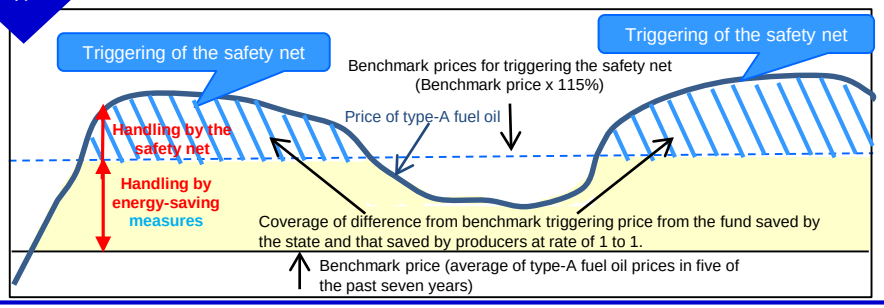
Preparation of plans to promote energy-saving and other measures in production areas

Example: Setting a reduction target for fuel use (more than 15%) and programs to attain the target
*In case of greenhouse horticulture and other production area launching measures



Support

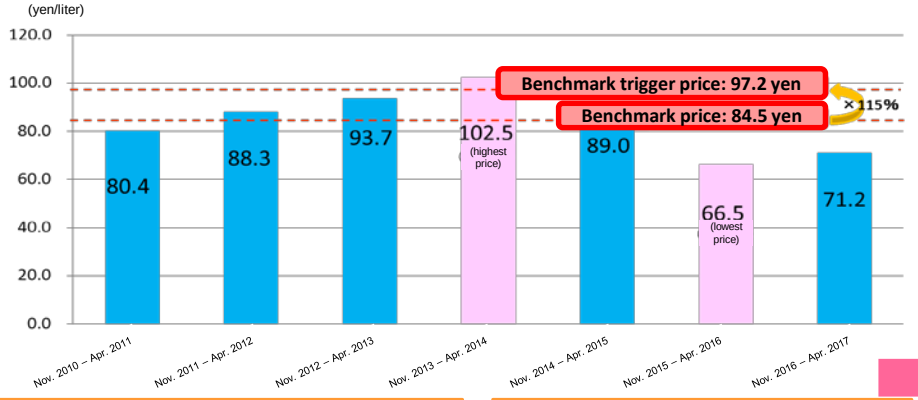
Support for creation of a safety net (subsidy rate: 1/2)



(Key points of countermeasures)

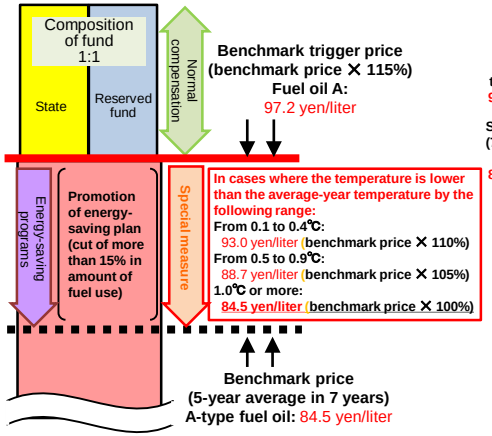
(Point 1) Benchmark prices for triggering the safety net

Using the average of type-A fuel oil prices in five of the past seven years or excluding two years of the highest and lowest prices as a benchmark, 115% of the benchmark serves as a benchmark triggering price.



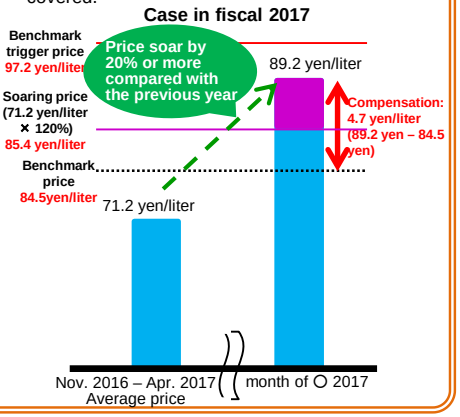
(Point 2) Special low-temperature measure

When the temperature in the year concerned falls below the average-year temperature, the benchmark trigger price is lowered in stages.



(Point 3) Special soaring temperature measure

When the fuel price rises above the average of prices during the previous year's warming season by more than 20% and also above the benchmark price, the difference from the benchmark price is covered.



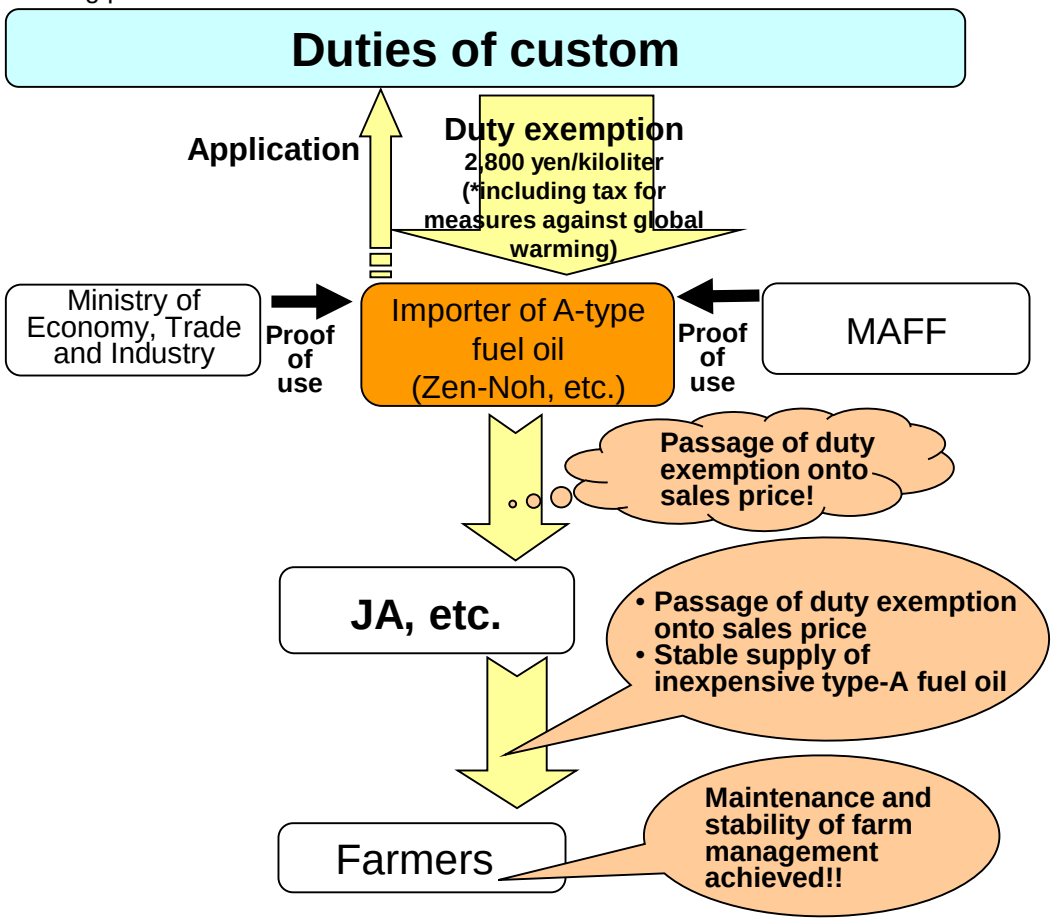
Shift to management resistant to sharp fuel price rises

5. Support for individual challenges (1) (fuel price [2])

- It is necessary to stabilize management through cuts in the burden on greenhouse horticulture farm households by supplying fuel oil for agricultural, forestry and fishery use stably at as low a price as possible and also to secure a stable supply of agricultural, forestry and fishery products.
- Implementation of exemption from oil and coal tax (2,800 yen/KL) related to imports of type-A fuel oil for agricultural, forestry and fishery use and of refund of amount (2,800 yen/KL) equivalent to oil and coal tax related to type-A fuel oil for agricultural, forestry and fishery use (special measures extended for three years for fiscal 2017 to 2019)

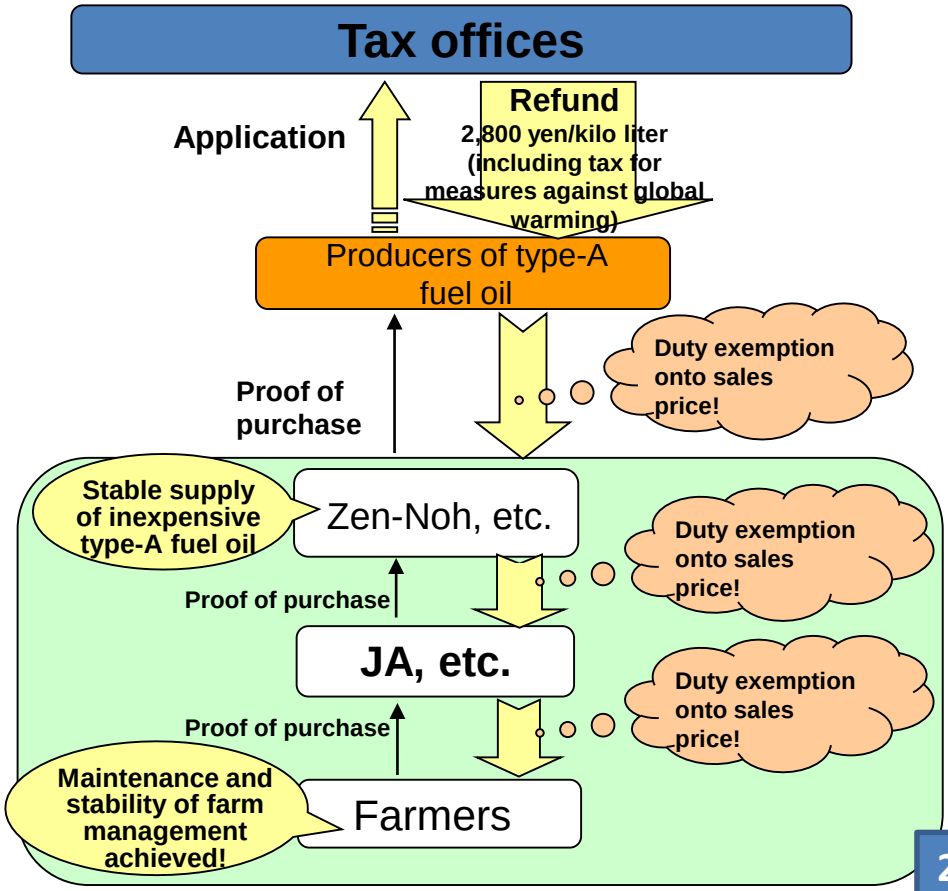
○ In case of type-A fuel oil imports for agricultural use

Importers (Zen-Noh, etc.) are exempted from oil and coal tax and pass it onto selling price for farmers



○ In case of domestic type-A fuel oil for agricultural use

If type-A fuel oil, produced in Japan from crude oil, with oil and coal tax already levied, is used in agriculture, an amount equivalent to oil and coal tax is refunded to producers who pass the exemption onto sales prices for farmers.



5. Support for individual challenges (2) (insects for pollen mating (honeybee))

○ Honeybees are used for pollen mating for strawberries, melons, water melons, etc. and their effects in Japan (use inside facilities) are estimated at about 73 billion yen.

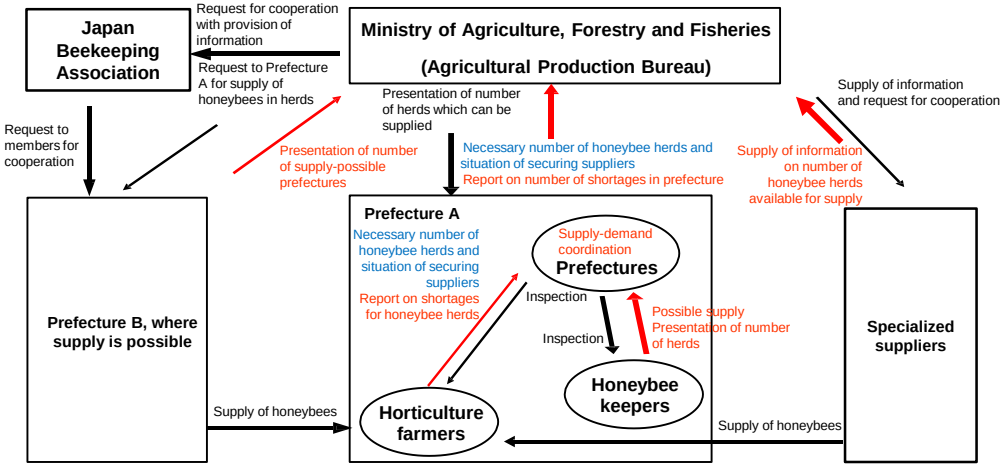
○ The Ministry of Agriculture Forestry and Fisheries created a supply-demand coordination system between horticulture farmers and honeybee keepers in fiscal 2009 to adjust supply and demand, when a honeybee shortage for pollen mating is expected, by sharing information on the prefectures in which supply is possible. But supply-demand balance has grown tighter due to damage caused by natural disasters and unseasonable weather conditions in recent years, so programs to achieve stable honeybee securement are necessary.

○ Situation of honeybee use for pollen mating in greenhouse horticulture of vegetables

Section of use	Total area (ha)	Ratio (%)
Area of greenhouse horticulture of vegetables (total)	39,635	
Of which, area of honeybee use	7,795	19.7
Area of strawberry cultivation	3,970	
Of which, area of honeybee use	3,553	89.5

Source: Ministry of Agriculture, Forestry and Fisheries, “Situation of Facilities Installed for Horticulture”

○ Supply-demand coordination system for pollen mating honeybees



○ Examples of damage caused by natural disasters


Hive boxes swept away by a typhoon

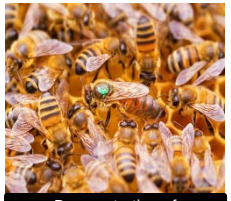

Hive boxes destroyed by earthquake

○ Support for stable procurement of honeybees for pollen mating

Support (from 2018) for expenses related to programs between horticulture production areas and honeybee keepers to prevent a shortage of honeybees for pollen mating (preparation of plans for cooperation between horticulture farmers and honeybee keepers, technology to ease damage using yellow hornet repellent, long-term sanitary utilization technology using biodegradable plastics as frames for hive boxes, technology for high-speed breeding of queen bees, technology to create an appropriate environment within a greenhouse, technology to prevent mite damage, technology to reduce dissipation in winter, efficient retreat from damage, etc.)


Preparation of plan for cooperation between horticulture production areas and honeybee keepers


Demonstration of technology for use of honeybees to raise the survival rate when they are returned to lenders


Demonstration of technology to produce honeybees at low cost

5. Support for individual challenges (2) (insects for pollen mating (bumblebees))

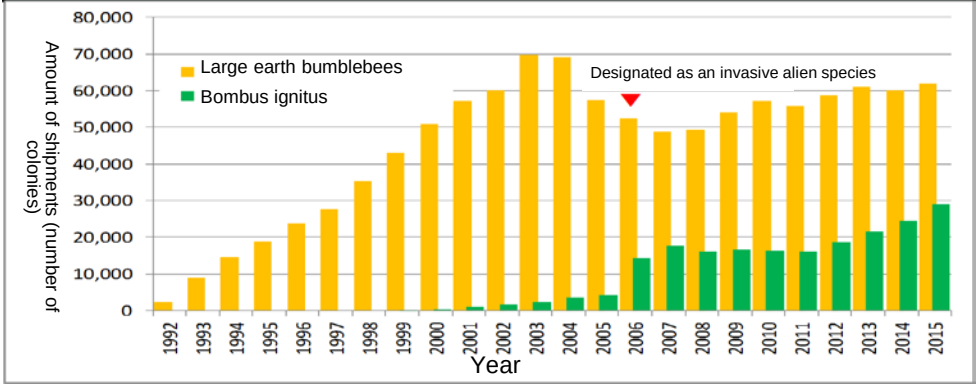
- Bumblebees are used for pollen mating for tomatoes and other produce grown inside facilities. Their economic effects in Japan (for use inside facilities) are estimated at about 5.3 billion yen.
- Bombus terrestris were designated as an invasive alien species in 2006 and the raising and keeping of them are banned in principle. The new introduction of them is also banned. If authorized by the Minister of Environment, raising and keeping them is possible as an exception.
- Shipments of Bombus terrestris have remained level since their designation as an invasive alien species, while the number of indigenous-breed bumblebees used has maintained a certain level. Bombus ignitus bumblebees have been found to be little different from Bombus terrestris in function.
- Based on these facts, the Ministry of Agriculture, Forestry and Fisheries and the Ministry of Environment decided in 2017 on the policy of using an alternative to Bombus terrestris and to accelerate the shift to an alternative to large earth bumblebees under the target of halving the use of Bombus terrestris by 2020.

Situation of using bumblebees for greenhouse production of vegetables

Section of use	Total area (ha)	Ratio (%)
Area of greenhouse vegetable production (total)	39,635	
Area of bumblebees used	2,905	7.3
Area of tomato cultivation	6,971	
Area of bumblebees used	2,665	38.2

Source: Ministry of Agriculture, Forestry and Fisheries, “Situation of Facilities Installed for Horticulture”

Changes in shipments of bumblebees



Policy of using an alternative to large earth bumblebees

- In Hokkaido, Bombus ignitus is not used, and the use of indigenous species (Bombus hypocritia sapporoenis) is demonstrated. The shift to them is being promoted since the demonstration.
- Outside Hokkaido, Bombus ignitus has been used under due management.
- Bumblebees are properly treated after use so that they do not fly into fields because they, even the indigenous species, have artificially uniformized genes.

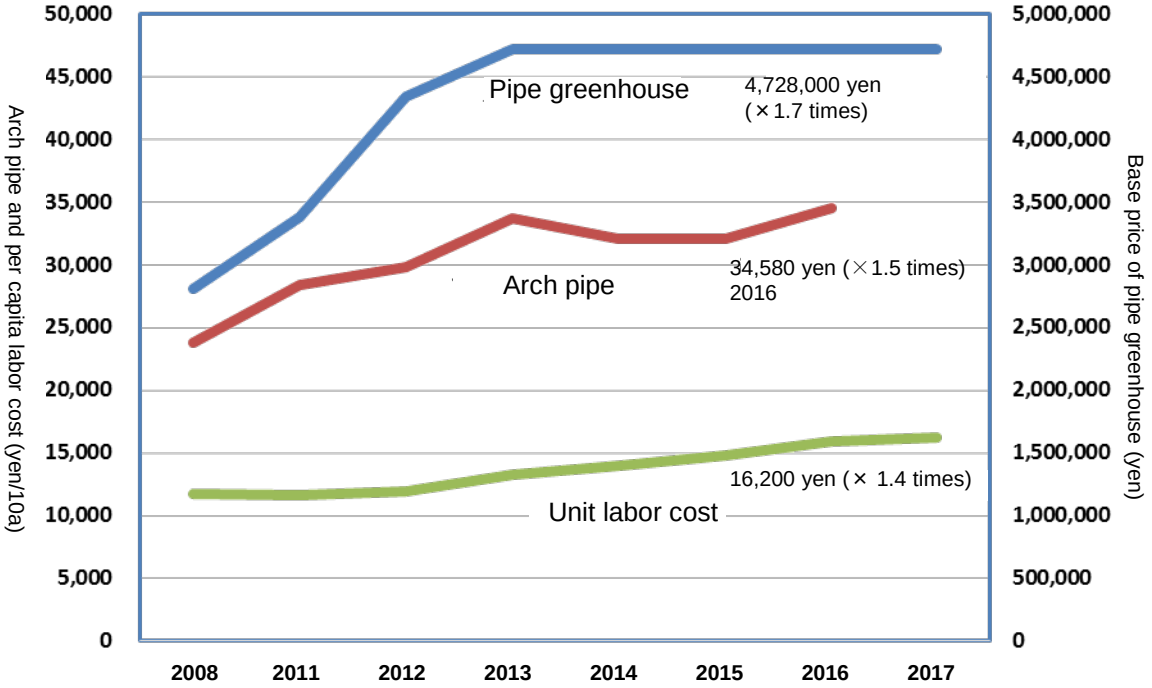
Support for increase in use of bumblebees of indigenous species

The Ministry of Agriculture, Forestry and Fisheries has supported demonstrations (since 2017) needed for the shift to bumblebees of indigenous species in horticulture production areas promoting planned efforts to half the use of Bombus terrestris.

5. Support for individual challenges (3) (Cost of building a greenhouse [1])

- Greenhouse prices have sharply increased in Japan in recent years against the backdrop of rises in material prices and labor cost.
- In greenhouse horticulture, the cost of building greenhouses needs to be lower as facility expenses account for more than 10% of farm management expenses.

The prices of greenhouses for agricultural use in Japan



Base price of a pipe greenhouse has risen by a factor of roughly 1.7 compared to 10 years ago.

Ratio of facility expenses to farm management cost

	Farm management cost (in 1,000 yen)	Ratio of facility expenses
Greenhouse horticulture of vegetables	620	13%
Greenhouse horticulture of flowers	1,563	12%
Open-field cultivation of vegetables	238	5%
Cultivation of fruits	291	7%
Cultivation of rice	103	6%

Facility expenses account for a large portion of farm management cost

Source: Ministry of Agriculture, Forestry and Fisheries, "Statistics on Type-by-Type Agricultural Management" (2015)

* Base price of a pipe greenhouse and price of arch pipes: Prices are quoted from greenhouse maker's catalogue (Arch price is for a set of 20 pipes) Price of arch pipes is not listed due to unavailability in the 2017 catalogue.
* Unit labor cost: Ministry of Land, Infrastructure, Transport and Tourism, "Public Works Design and Unit Labor Cost (Ordinary Workers)" (Unit cost in Kumamoto Prefecture)

5. Support for individual challenges (3) (Cost of erecting greenhouse for agricultural use [2])

○ To cut the cost of erecting greenhouses for agricultural use based on "Programs to Reinforce Competitiveness of Agriculture," (1) Preparation of a guidebook for introducing weather-resistant greenhouses, (2) Development and dissemination of technology to cut the cost of weather-resistant greenhouses, and (3) Promotion of self-building of pipe greenhouses, etc. will be promoted.

Furtherance of excessively large space by leaving strength and specifications to makers

To shift the design standard for weather-resistant greenhouses from "industry standards" to "Guidebook for Farmers."

○ Preparation of a guidebook in 2018 to enable farmers to strengthen greenhouses and specifications matching their own management.
(Before the guidebook, a leaflet was prepared in fiscal 2017 to sort out in simple terms ideas for choosing necessary strength.
At the time of preparation, rules for wind resistance, snow resistance, weight resistance, and other issues of concern for greenhouses were relaxed.

Exploration, development and dissemination of information of cost-cutting technology.

○ Preparation of a low-cost technology catalogue and collection of examples of low-cost cases through exploration of technologies, including regional small and midsize makers (convening of technology proposal session) in fiscal 2017
○ To demonstrate and establish a greenhouse capable of cutting the cost of building a greenhouse per se and interior facilities by 30% from the current level by fiscal 2019 (project to reinforce the management unit under the fiscal 2016 supplementary budget)

30% cut in cost of erecting a weather-resistant greenhouse

◎ Prevention of over specifications and dissemination of high quality and low-cost greenhouses for agricultural use through farmers' selection
◎ Establishment of technology capable of cutting materials cost and building cost combined by 30% through innovation

High building cost

Promotion of self-construction of pipe greenhouses by agricultural corporations and JA working groups

○ Preparation of a self-building manual for farmers by Zen-Noh in fiscal 2017

20% cut in cost of erecting pipe greenhouses

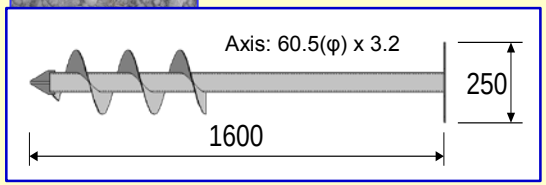
◎ Cut (20%) in building cost by self-construction

(Reference) Specific programs to cut the cost of improving facilities

○ Example of technological development (technology revealed at a technology proposal session)

- Cut in building cost by means of the pile foundation method

(Features)
Construction period is shortened and direct driving piles eliminates the boring work and formwork needed in groundwork



Technology catalogue is posted on the Ministry of Agriculture, Forestry and Fisheries website
http://www.maff.go.jp/j/seisan/ryutu/engei/onshitsu.html

○ Leaflet for farmers

- Preparation of leaflet in fiscal 2017, sorting out ideas in plain terms for selecting needed strength

➢ Strength resistant to strong wind (wind-resistance design value)

Location of building ~~erection~~ (example)	Return period			
	15 years	22 years	30years	43years
Mito City, Ibaraki Prefecture	① 28m/s	28m/s	② 29m/s	30m/s
Yokkaichi City, Mie Prefecture	③ 42m/s	44m/s	④ 46m/s	48m/s

A greenhouse with the strength to withstand strong winds, as mentioned above, is shown below as an example for reference. As it is no more than an example, necessary strength can be obtained by different specifications, such as the shape of greenhouses and diameters of poles (for example, changing the diameter of the pole under a chevron-shaped roof house)

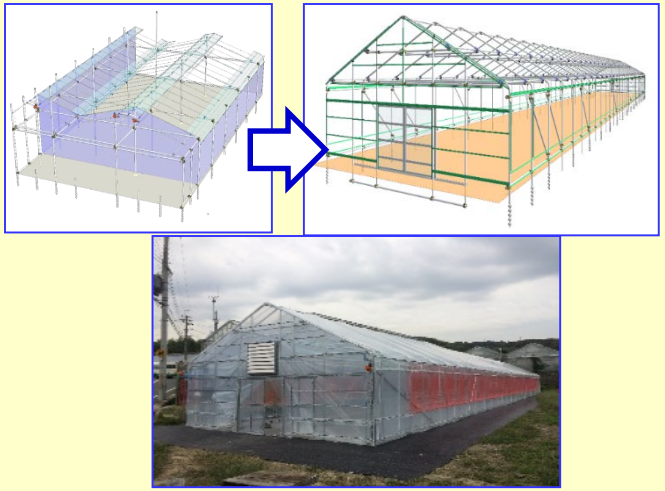
	①	②	③	④
Example of greenhouse specifications	Dome-shaped roof house	Dome-shaped roof house	Single chevron-shaped roof house	Single chevron-shaped roof house
Frontage and height of eave	7.2m、3.0m	7.2m、3.0m	8.0m、2.7m	8.0m、2.7m
Kinds of main aggregate	□-75*45*2.3	□-100*50*2.3	LH-150*75 *3.2*4.5	LH-200*100 *3.2*4.5
Strength	Low ⟷ High			
Price	Low ⟷ High			

*□ represents a square steel tube and LH means light wide flange beam

The leaflet is posted on the Ministry of Agriculture, Forestry and Fisheries website
http://www.maff.go.jp/j/seisan/ryutu/engei/attach/pdf/onshitsu-15.pdf

○ Studies on project to reinforce management unit (Technology introduced at technology proposal session)

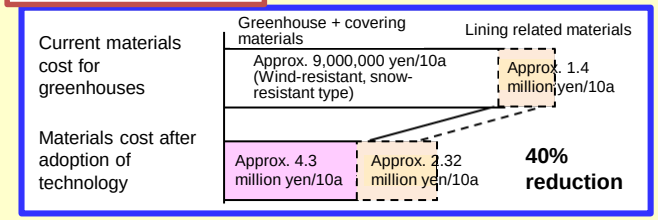
- Small-scale, low-cost greenhouse utilizing materials for construction scaffolding



(Features)
The utilization of general-purpose materials used to build construction scaffolding cut materials cost
Demonstration is underway to examine the cut in construction expenses and productivity

(2017 to 2019)

Expected effects



Increase in farmers' income and expansion of greenhouse horticulture market

(Attached table 1) Farm management model (Greenhouse horticulture (family-run))

Food, Agriculture, Rural Areas Basic Plan (March 2015)
Reference material (excerpt)

- Display of ways toward business expansion and income increase as a model of "efficient and stable farm management" by bearer of greenhouse horticulture
- Model of family-run greenhouse horticulture shows a gross revenue of 100 million yen through labor saving and an increase in unit yield by means of environmental control technology

Types of agricultural management	Vegetable cultivation (greenhouse horticulture)	Area covered	Across country

Key points of model

Family-run business seeking to expand operations and improve productivity by adopting environmental control technology, etc. and concluding direct sales contracts with actual users.

Outline of technology and program

- Labor saving and expansion of operations by adopting environmental control technology to automate temperature, humidity, and other adjustments.
- Sharp increase in amount of production (from 10.4t/10a to 35t/10a) by adopting high-yield products with high sugar content, a hydroponic system, long-term cultivation and the environmental control technology in ICT.
- Creation of local employment throughout the year by realizing year-round cultivation
- Cost reduction by adopting heat pumps and other energy-saving devices
- Conclusion of direct sales contracts and realization of stable management and sales route expansion by producing tomatoes of the quality demanded by consumers

Feature of management development

(Type of management)
Family-run (two people and 17 temporary employees)

(Scale of management and type of cropping)

Arable land under management	1ha
Vegetables subject to greenhouse horticulture	
Tomatoes	1ha
Settled planting	August
Shipment	From September to July of the following year

(Results of estimation)

Gross revenue	105 million yen
Management expanses	93.4 million yen
Labor cost	21.5 million yen
Agricultural income	11.6 million yen
Income of main worker (per person)	5.8 million yen
Work hours by main worker (per person)	1,800 hours

(Reference) Feature of average worker primarily engaging in agriculture

(Type of management)
Family-run (2 people and 1 temporary employee)
(Scale of management and type of cropping)

Arable land under management	0.33ha
Vegetable subject to greenhouse horticulture	
Tomatoes	0.33ha
Settled planting	September
Shipment	From November to June of the following year

Topics of production technology

Long-term cultivation (tomatoes)

- Longer harvesting period than before and large increase in amount of production thanks to a hydroponic system using a high wire system

Compound environmental control system

- Pursuit of optimal growth environments and cost reduction through the combination of compound environmental control system and energy-saving equipment

- Implementation of direct contract sales to supermarkets, department stores, restaurants, sellers of home-meal replacements, etc.

(Attached table 2) Farm management model (greenhouse horticulture (run by corporation))

○Model of corporation-type greenhouse horticulture shows gross revenue of 500 million yen utilizing ICT and regional energy at large-sized greenhouses

Types of agricultural management	Vegetable cultivation (next-generation greenhouse horticulture)	Area covered	Nationwide

Key points of model

Corporate management engaging in integrated next-generation greenhouse horticulture from production to coordination to shipment, combining local energy, such as wooden biomass, and cutting-edge technology

Outline of technology and program

- Labor saving by environmental control technology and expansion of operations by promoting amassment of farmland and securing deserted arable land and industrial parks, etc.
- Sharp increase in amount of production (from 10.4t/10a to 35t/10a) by adopting high-yield products with high sugar content, a hydroponic system, long-term cultivation and the environmental control technology in ICT.
- Creation of local employment throughout the year by realizing year-round cultivation
- Utilization of local energy, such as wooden biomass, to break away from the reliance on fossil energy (30% cut in use of fossil energy)
- Realization of stable management and securement of sales routes through direct contract sales (from 304 yen/kg to 350 yen/kg)

Feature of management development

(Type of management)
Management by corporation (4 people, 6 full-time employees and 82 temporary employees)

(Scale of management and type of cropping)

Arable land under management	4ha
Vegetables subject to greenhouse horticulture	
Tomatoes	4ha
Settled planting	August
Shipment	From September to July of the following year

(Results of estimation)

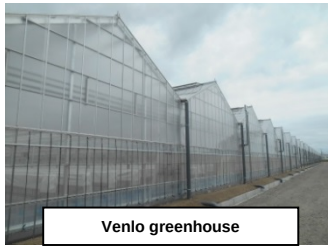
Gross revenue	490 million yen
Management expanses	434.5 million yen
Labor cost	123.6 million yen
Agricultural income	55.5 million yen
Income of main worker (per person)	13.9 million yen
Work hours by main worker (per person)	1,800 hours

(Reference) Feature of average worker primarily engaging in agriculture

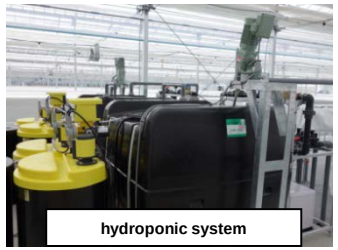
(Type of management)
Family-run (2 people and 1 temporary employee)
(Scale of management and type of cropping)

Arable land under management	0.33ha
Vegetable subject to greenhouse horticulture	
Tomatoes	0.33ha
Settled planting	September
Shipment	From November to June of the following year

Topics of production technology


Venlo greenhouse

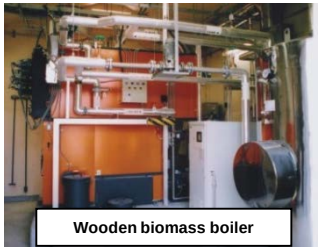

Roof window, curtain and cyclical fan

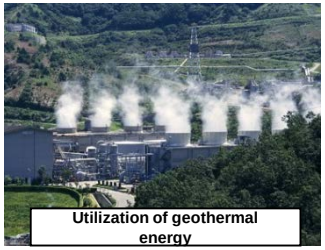

hydroponic system


Screen of an environmental control system

Compound environmental control system

○Control of temperature, humidity, CO2, amount of insolation, amount of fertilizer used, etc. by utilizing ICT


Wooden biomass boiler


Utilization of geothermal energy

○Breakaway from fossil energy by utilizing local energy, including wooden biomass