



National Agriculture and Food Research Organization

Western Region Agricultural Research Center



Food and Agriculture for the Future

■ The National Agriculture and Food Research Organization

The world is faced with significantly increased demand for food owing to population increase and to rapid economic development in developing countries. Resources indispensable for food production, such as farmland and water, are becoming scarce, and the environment surrounding Japanese agriculture and farming communities is moving towards uncertainty.

The National Agriculture and Food Research Organization (NARO) is making every effort in research and development through its 14 research institutions to resolve issues associated with food, agriculture, and farming communities; to create a prosperous Japanese society in the 21st century; and to contribute to the conservation of the global environment.

In addition, to achieve the full potential of research, NARO is actively promoting the timely dissemination and practical application of research achievements among industry, academia, and government through means such as collaborative research.

NARO has launched its third 5-year mid-term plan*, starting from FY 2011. During this third term, we plan to strengthen collaboration among research institutions and to further expand project-focused research.

■ Role of the Western Region Agricultural Research Center

The Western Region Agricultural Research Center (WARC) is determined to engage in research and development with M (mission), V (vision), and P (passion) to solve various problems facing agriculture in hilly and mountainous areas, which are characteristic of the Western Region of Japan, and to revitalize the region.

WARC has four research stations (in Fukuyama city, Hiroshima prefecture; Zentsuji city, Kagawa prefecture; Ayabe city, Kyoto prefecture; and Ohda city, Shimane prefecture) and six research divisions (see figure on the right) in which we promote research and development.

In the third term, we will focus our research mainly on the six projects listed below. We are also actively promoting cooperation among industry, academia, and government so as to concentrate on pioneering research and development that can contribute to the advancement of the agriculture and food industry sector of the Western Region.

Key Projects for the Third Mid-term Plan Period at WARC

- Development of a highly productive paddy rotation system for small- and medium-scale farming
- Development of characteristic quality beef production technology by using self-supplied feed such as forage rice and grass for Japanese Black cattle
- Development of a sustainable production system in greenhouse horticulture for the Western region
- Development of a profitable citrus production system based on biological information and orchard modeling
- Development of a nutrient dynamics model and agricultural technologies for water quality conservation of catchments
- Development of a sustainable vegetable production system based on rapid diagnosis of soil-borne pest and bio-intensive pest management

* The mid-term plan period is the length of time in which the operational goal of the research center is to be reached. A term at NARO is 5 years.

Organization



Farming Systems and Agro-Environmental Technologies Research Division

The division is responsible for the identification of measures for promoting agricultural production in the Western Region; the development and systematization of labor-saving technologies for rice paddies; the development of information technologies to increase production efficiency; and the development of environmental load assessment methods applicable to the Inland Sea coastal areas.

Construction of a business model to diversify regional agriculture

To revitalize agriculture in hilly and mountainous areas with an aging and diminishing population, a core coordinating organization is indispensable. We have confirmed that a system that coordinates cooperation among collectives of farm households has the power to stabilize the management of each collective, even when collectives straggle over a wide area.

In the third term, we will present a business model by which even small-scale farmers can make a sufficient profit by bridging the interactions between the sellers and processors of local agricultural produce and the consumers, giving priority to farmers' markets.



A thriving farmers' market

Development of labor-saving technology for paddy fields and agricultural information technology that supports decision making

In the Western Region, small- and medium-sized paddy fields are scattered across a wide area. Therefore, measures for labor-saving and optimizing farm work are much in need. We have developed a no-till technique for sowing soybeans in paddy fields; a speed-linked fertilizer drill; a high-precision technique for sowing sunflowers; a small-scale system for harvesting forage rice; a system for predicting the growth of paddy rice; and a farm work planning and management support system.

In the third term, to decrease production costs in small- and medium-sized paddy fields, we will develop labor-saving techniques for growing wheat and soybean through minimum tillage; a sowing and fertilizing system that can easily be adjusted to field and work conditions; a forage rice harvesting system with ensiling on farm; an information system in which data can be integrated and visualized on a map; and an information recording system based on a personal digital assistant.

Speed-linked fertilizer drill



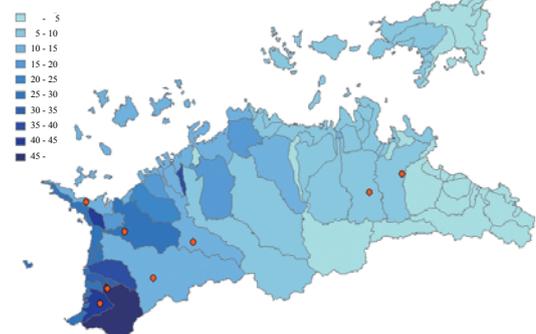
Farm work planning and management support system,

Development of an environmental load reduction technology and impact assessment of technology introduction

The Western Region is home to closed waters such as Lake Biwa and the Seto Inland Sea, and so increased loads on the environment due to excessive nutrient input into farmland are of concern. For this reason, we have developed a water purification technique that uses farm ponds and resting rice fields and a solar-powered drip-irrigator that recycles nutrient-rich groundwater in proportion to the intensity of solar radiation. We have also developed a method for estimating estuarine water quality from land use in the catchment, and a method for assessing river and groundwater nitrogen loads from estimates of fertilizer nitrogen unused by crops.

In the third term, we will develop an environmental load reduction technology; a method for assessing environmental impacts associated with its introduction; a water quality prediction model; and a method to evaluate measures to reduce environmental loads in waters.

Estimated amount of unabsorbed nitrogen (kg/ha)



Estimated amount of fertilizer nitrogen unused by crops (by river catchment in Kagawa prefecture)

●Locations where nitrate nitrogen concentration in groundwater exceeds 10 ppm

Lowland Crops Research Division

The division focuses on the development of low-cost technology for the stable production of high-yield crops and vegetables that takes advantage of the weather and land conditions of the Western Region, on the development of sustainable production technology, and on the breeding of high-quality, easily grown rice and wheat cultivars that are adapted to the region.

Breeding of paddy rice and wheat cultivars that are adapted to the region

We bred a paddy rice cultivar, 'Himegonomi', with a very sticky grain that does not go hard when cold, and a forage rice cultivar, 'Tachisuzuka', with a high straw yield.

In the third term, we are planning to breed rice cultivars for processing, such as for rice flour; to increase the demand for rice; and to expand the use of rice paddies.

We bred three new wheat cultivars that produce grain that makes Japanese noodles with superior texture: 'Fukusayaka', 'Fukuhonoka', and 'Fukuharuka.'

In the third term, we are planning to breed bread wheat cultivars with the aim of increasing the domestic production of wheat.



'Tachisuzuka'

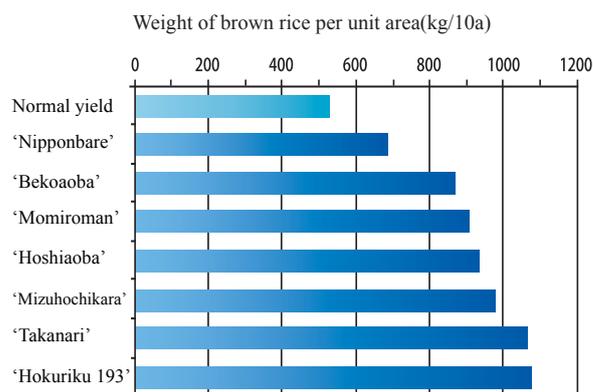


'Fukuhonoka'

Development of a paddy rice culture method that overcomes or takes advantage of global warming

With the progression of global warming, the decline in the quality of rice grain due to high temperatures during summer is a growing problem. Yet, high-yielding rice is well adapted to cultivation under high temperatures and strong sunshine, producing 10 t/ha in this region.

In the third term, we are planning to identify the physiological properties of heat-resistant cultivars, and to clarify the responses of growth and yield of high-yielding rice to weather conditions. We are also planning to further our research on accurately estimating regional meteorological data to support technology that can help stabilize the quality of rice under various environmental conditions in this region, and to develop a stable and high-yielding cultivation technology.



Yield potential of new, high-yielding cultivars of rice

Development of an aphid control method using a flightless strain of *Harmonia axyridis*

Harmonia axyridis, a coccinellid beetle, is a natural enemy of aphids, but is rarely used in practice, since the adults easily fly away. We bred a flightless strain of *H. axyridis* that stays on the crop and has a high capacity to control aphids.

In the third term, we will develop a method to use this flightless strain in open fields of vegetables. To promote the use of such predators, we will clarify what makes them effective as natural enemies and breed lines with these enhanced qualities.



Flightless strain of *Harmonia axyridis*

Crop Breeding and Food Functional Components Research Division

To establish lowland crop rotation systems in the Western Region and to increase demand for and support the branding of local agricultural products, the division is responsible for breeding hull-less barley and soybean cultivars and for identifying health functions of agricultural products, and to develop technologies for their effective use.

Breeding of hull-less barley with stably high-yielding, superior quality, and for new uses

There is a strong demand for the increased production of barley (especially hull-less barley), so the breeding of highly profitable cultivars that contribute to the expansion of production and stable supply is crucial.

So far we have bred a six-rowed high-yielding cultivar, 'Toyonokaze'; a two-rowed large-grain cultivar, 'Yumesakiboshi'; and a two-rowed waxy cultivar, 'Kirari-mochi', with good texture, a high β -glucan content, and little discoloration after cooking.

In the third term, we are aiming to breed stably high-yielding, good-quality cultivars (for example, low glassy grain rate, short pearling time, low grain loss rate) that are good to use for miso processing and for eating with rice or flour. We are also aiming to breed cultivars that are well adapted to hilly and mountainous areas. Furthermore, by using DNA markers, we are planning to develop hull-less barley lines that are resistant to diseases and suitable for pearling. We are also planning to breed high-value-added hull-less barley cultivars that have rich dietary fiber (β -glucan) content for new uses.



'Kirari-mochi' 'Ichibanboshi' (control)

Cooked 'Kirari-mochi' barley (after warm incubation for 18 hours)

Breeding of soybeans with stably high yield and high quality, and development of quality control technology

Soybeans are a major ingredient in traditional Japanese foods, such as tofu, miso, and *natto*. The breeding of new cultivars is indispensable to improving self-sufficiency and to ensuring a stable supply of safe and secure domestic soybeans. So far we have bred two cultivars: 'Hatusayaka' has less 'delayed leaf senescence' and is suited to tofu processing; 'Akimaro' produces high yields when sown late and is well suited to miso production.

In the third term, by using DNA markers and other measures, we will introduce resistance to important pests, shattering resistance, and other characteristics into leading cultivars so as to breed soybeans that have stable high yields of high quality in the temperate climate of the Western Region. In addition, we will breed labor-saving high-yield lines by modification of agronomic characteristics such as plant types.

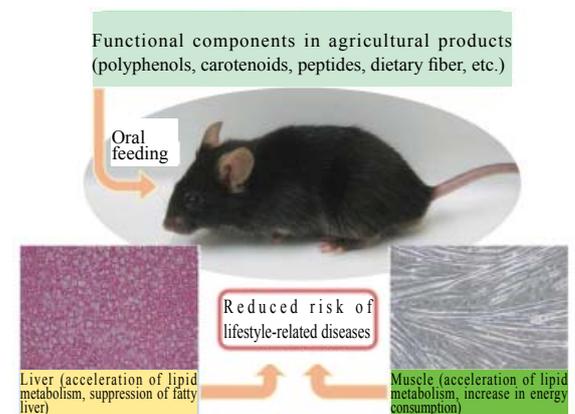


'Hatusayaka' (left) has less delayed leaf senescence than 'Sachiyutaka' (right)

Investigation of health functions of agricultural products and development of effective utilization technology

Lifestyle-related diseases have become a social problem in recent years. Therefore, the identification of food components that can help prevent or reduce disease is required. So far we have discovered several active food components, established methods to extract and purify them from byproducts of wheat and rice milling, and revealed their functions.

In the third term, we are hoping to identify the functional components that increase lipid metabolism in muscles and liver, and to identify functional components in barley that can control digestion. Furthermore, with the aim of commercializing components with immunomodulatory and anti-aging effects, and hypotensive peptides derived from wheat bran, we will clarify their effectiveness at improving liver function.



Uncovering the special qualities of functional components through animal experiments

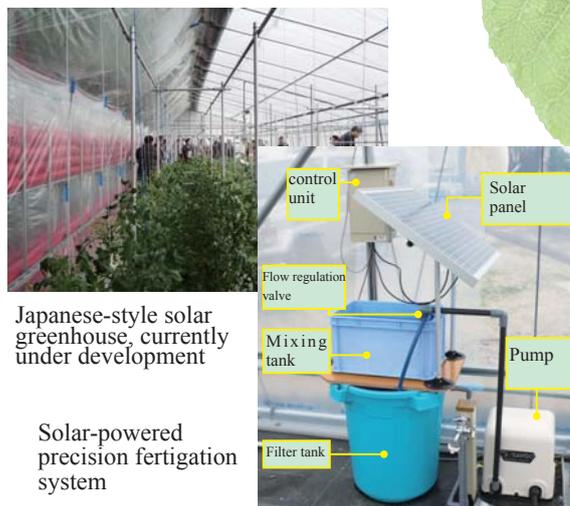
Hillside Horticulture Research Division

The division is devoted to research on the production of vegetables and fruits on sloping land in the Western Region, especially for the development of protected horticulture systems that achieve stable and profitable production in warm areas, and for the development of cultivation techniques to improve citrus production.

Production of summer and autumn tomato in mountainous areas

In mountainous areas with a poor production base, protected horticulture offers an advantage in profitable production because of high land productivity. We developed a low-cost, high-strength greenhouse suitable for mountainous areas and a labor-saving hydroponic system to permit summer and autumn tomato production.

In the third term, we are planning to develop a Japanese-style solar greenhouse that uses solar heating to halve fuel consumption in winter, to contribute to profitable production by farmers in and around mountainous areas. In addition, we will integrate a greenhouse which utilizes construction scaffolding materials, a solar-powered precision fertigation system, and an inexpensive cooling system to ensure the stable production of densely planted tomatoes.



Japanese-style solar greenhouse, currently under development

Solar-powered precision fertigation system

Development of labor-saving, comfortable work systems for horticulture

Since horticultural production in mountainous areas is often labor-intensive, labor-saving and load-lightening technologies are needed. We developed a walking-type harvester and a system for harvesting small-flowered chrysanthemums.

In the third term, we are planning to develop a monorail conveyor for sloping orchards; and a planting system and environmental control technology aimed at reducing the work load and improving comfort in protected horticulture using densely planted movable beds. In addition, we will put the chrysanthemum harvester and the harvesting system into practical use.

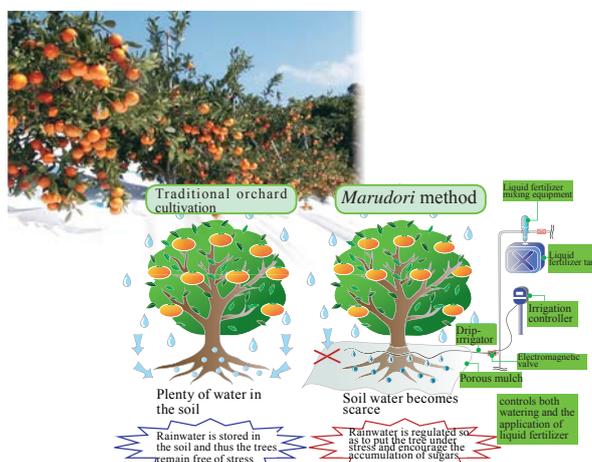


Harvester for small-flowered chrysanthemums

Development of technology to support upgrading of citrus production

Under the continued low price for Satsuma mandarins, impoverishment of production areas is advancing quickly owing to the heavy workload and decreases in the number of farmers. Therefore, the introduction of new medium- and late-maturing citrus cultivars and the improvement of farming infrastructure need immediate attention. So far, to reduce labor for the production of high-quality fruit, we have developed a drip irrigation and liquid fertilization system with year-round plastic mulching (the *Marudori* method) for the production of Satsuma mandarins.

In the third term, we will develop technology for the stable production of high-quality medium- and late-maturing citrus cultivars. In addition, we will improve the condition of hillside orchards, the basis of production in the citrus growing areas; and develop technology to save labor, ease workload, and improve the efficiency of management work, which is primarily conveyance. We will also encourage a shift to new cultivars; and support the establishment of a citrus brand to expand the region's citrus production.



Marudori method for growing Satsuma mandarins

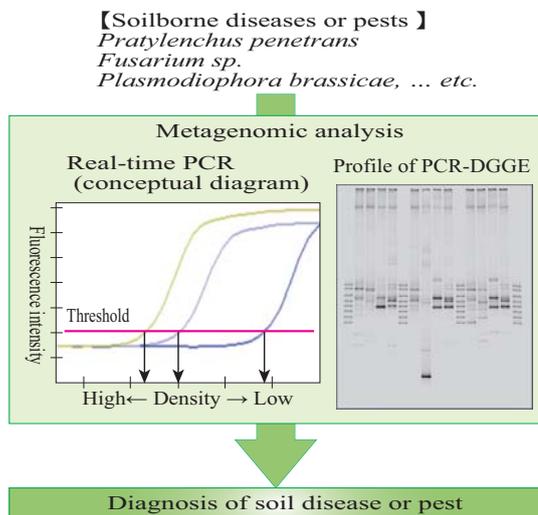
Sustainable Vegetable Production Research Division

The division aims to achieve stable and sustainable vegetable production by decreasing the use of chemical pesticides; to develop technology to diagnose soilborne diseases and pests; to devise a cultivation technique to suppress diseases and pests; and to devise a technique for controlling growth.

Development of methods to diagnose damage to vegetables caused by soilborne diseases and pests using metagenomic analysis

Agrochemicals tend to be applied unnecessarily to fields, because there are no methods that can satisfactorily diagnose damage to vegetables caused by soilborne pathogens or pests. We have been studying the relationships between soilborne diseases or pests and soil organisms. We have developed a method for quantifying plant-parasitic nematodes using metagenomes recovered directly from environmental samples such as soil. This technique is faster and easier than traditional extraction methods, which require skill and time.

In the third term, to create a sustainable vegetable production system, we are planning to develop a high-sensitivity assay using metagenomics and to establish economic thresholds for damage to vegetables caused by nematodes or soilborne pathogens.



Sustainable soil sterilization by soil reduction using untapped regional resources

The technique of soil sterilization by soil reduction, to control diseases and pests, uses wheat and rice bran as organic matter. To increase its sterilization capacity, we grew crucifers such as *Brassica juncea*, which contain antibacterial substances, and incorporated them into the soil. This measure avoids the purchase of organic matter and is readily available.

In the third term, to lower the cost of soil sterilization by soil reduction, we will take advantage of harvest residues of, for example, broccoli, processing residues of pickled turnip, and other unused regional resources that have long been discarded.



Development of a disease control technology for summer spinach

Development of lighting-control technology to control plant growth and diseases and pests

Technology to control the light environment would contribute to sustainable agriculture. So far, we have examined the pest control effects of light conversion materials and the aging of such materials; identified the light quality for a moth-repelling lamp with a minimum impact on strawberries; and identified the relationship between the content of ascorbic acid (vitamin C) in spinach and the amount of solar radiation before harvest.

In the third term, to improve the yield and quality of spinach and strawberry and to control diseases and pests, we will develop a practical lighting-control technology, including new coating materials, lighting techniques, and shade culture techniques.



Monochromatic light tests on plants

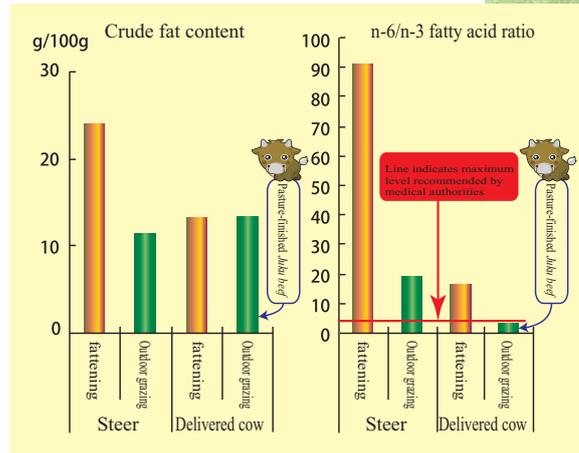
Livestock Production and Wildlife Management Research Division

The division is conducting research on the production of Japanese Black cattle using regional feed resources, and on managing damage caused by wildlife.

Development and evaluation of beef production through feed self-sufficiency

The production of beef cattle holds an important place in hilly and mountainous areas, and the improvement of feed self-sufficiency is a challenge in Japan. In addition, consumers are favoring leaner meat. So far, we have proved that beef with a low fat content, a favorable ratio of essential fatty acids and a characteristic flavor (pasture-finished *Juku beef*[®]) can be produced by grazing aged Japanese Black cows beyond breeding age and with low market value.

In the third term, we will identify the characteristics of self-supplied feed such as whole-crop rice silage and pasture for fattening by analyzing nutrition after feeding in order to develop a method for producing high-quality beef. In addition, we will develop a new method for evaluating meat quality that can better illustrate the characteristics of the beef.



Crude fat content of longissimus muscle (sirloin) and n-6/n-3 fatty acid ratio

Development of a feed management technology based on nutrient dynamics and reproduction of beef cows

Grazing is effective as a means to feed Japanese Black beef cows and to manage abandoned farmland. So far, we have published a manual that summarizes the results of collaborative research on problems such as nutrition management, b b breakouts from fences, and water pollution that need to be dealt with when cattle are moved around between abandoned farmlands for grazing.

In the third term, we will develop a low-cost feed management technology that considers environmental load and can extend the grazing period by making full use of a variety of self-supplied feed resources such as whole-crop rice silage and grazing. We are also aiming at the reproduction of one calf per year by using blood composition as an index for managing nutrition and thereby maintaining the health status of Japanese Black breeding cows.



Rotational Grazing Q&A (can be downloaded from the WARC website)

Wildlife management by local residents

Wildlife management that focuses on trapping and extermination is not very successful in reducing damage. For this reason, we took a different approach and showed that the removal of crop residues and food wastes, village-wide efforts to chase away wildlife, and cultural techniques that can cope with wildlife damage such as low tree height and bamboo ground protection proved successful in wildlife management and revitalizing the region.

In the third term, through behavior analysis of wildlife such as wild boars and sika deer, we will develop better wildlife barriers and a wildlife management program that could be practiced and developed by local residents.



Bamboo ground protection used to stop monkeys digging

Open-type Research Facility (Open Lab)

WARC opened its labs to all researchers to promote collaboration among industry, academia, and government in the region. Equipped with various analytical instruments, the labs are expected to be actively used by producers, distributors, processors, public testing and research organizations, universities, and others as a place for research and exchange.

Agricultural Product Componential Analysis Open Research Facility (Fukuyama, Hiroshima)



General Information: The following equipment is available:

- Flour test mill
- Scanning electron microscope
- Gas chromatograph mass spectrometer(GC-MS)

applications and inquiries
Department of Planning and General Administration,
Planning and Promotion Section +81-84-923-4107

Sloped Land Agriculture Open Research Facility (Zentsuji, Kagawa)



General Information: The following equipment is available:

- High-performance liquid chromatograph
- Spectrophotometer
- Meteorological observation equipment
- Tilt table for evaluation of vehicle stability on slopes
- Fume hoods
- Microwave decomposition equipment

applications and inquiries
Department of Planning and General Administration,
Shikoku Planning and General Administration Section
+81-877-63-8104

Second Joint Experiment Building (Zentsuji, Kagawa)



General Information: The following equipment is available:

- Single kernel classification system for wheat and barley
- High-performance liquid chromatograph
- Time-of-flight mass spectrometer
- Near-infrared spectrometer

applications and inquiries
Department of Planning and General Administration,
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Please visit our website

http://www.naro.affrc.go.jp/org/warc/gyomu_suisin/open_lab/

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History

April, 1950	The following institutes were integrated into Chugoku--Shikoku Agricultural Experiment Station, Ministry of Agriculture, Forestry and Fisheries <ul style="list-style-type: none"> • Chugoku Branch of the Agriculture Experiment Station (Himeji-shi) • Shikoku Branch of the Agriculture Experiment Station (Zentsuji-shi) • Chugoku Branch of the Livestock Experiment Station (Ooda-shi) • Chugoku Branch of the Cultivation Research Center (Mizoguchi-cho, Hino-gun, Tottori)
August, 1952	The Second Department of Cultivation (except for Sweet Potato Laboratory) and the Land Use Department of Chugoku-Shikoku Agricultural Experiment Station, Ministry of Agriculture, Forestry and Fisheries was spun off as the Shikoku Agricultural Experiment Station. The remaining part was redesignated as the Chugoku Agricultural Experiment Station The General Affairs Division, the Cultivation Department, and the Land Use Department were established in the Shikoku Agricultural Experiment Station
December, 1983	Kansai Branch of Sericulture Experiment Station, Ministry of Agriculture, Forestry and Fisheries was integrated to Chugoku Agricultural Experiment Station as Department of upland farming
April, 2001	Chugoku Agricultural Experiment Station and Shikoku Agricultural Experiment Station were integrated into the National Agricultural Research Organization, National Agricultural Research Center for Western Region
October, 2003	Changed its name to the National Agriculture and Bio-oriented Research Organization
April, 2006	Changed its name to the National Agriculture and Food Research Organization
April, 2011	Reorganized into research division structure, and the third mid-term plan was launched.

Various results of research, event information, and publications such as brochures and technical manuals are available from our website. Please visit our website.

<http://www.naro.affrc.go.jp/warc/>

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Front cover: Background, rice terraces in a hilly to mountainous region (photo courtesy of Mr. Ichiro Taniyama). Upper left, a high-sugar-content forage rice, 'Tachisuzuka' (taller plants in photo). Upper right, 'Hatusayaka' soybean. Lower right, landscape with cattle grazing. Lower left, strawberry high-bench culture with medium-cooling system using latent heat of evaporation.



Some information is accessible from mobile phones. Please use this QR code.

