

Reinventing Japan's Agriculture, Forestry, and Fisheries Industry as the Ultimate Knowledge Industry

Japan's agriculture, forestry, and fisheries industry faces an ever-growing number of difficult issues. Reinventing this industry will require refined production technologies that produce high-yield, high-quality agricultural goods, as well as groundbreaking, highly profitable high-function products. The future of Japan's agriculture lies in the singular path of bringing agriculture and agriculture management back to the forefront, collecting technologies and expertise from a broad range of fields to produce goods capable of competing in global markets. The SIP has set its sights on achieving ambitious numerical targets over the next five years, including cutting by half the labor required for rice production and developing breeding technologies for a threefold gain in rice plant yield. This is nothing less than reinventing the agriculture, forestry, and fisheries industry as the ultimate knowledge industry.

Technologies
for Creating
Next-Generation
Agriculture, Forestry
and Fisheries
Creating Agro-Innovation

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Profile

Professor Takeshi Nishio served in various positions within Japan's Ministry of Agriculture, Forestry and Fisheries until 2006, including posts related to plant protection policy, Director of Soil and Agricultural Chemicals Division, Water Quality Bureau, Environment Agency, Research Councilor of the Agriculture, Forestry and Fisheries Research Council Secretariat, and Director General of the Policy Research Institute of the Ministry of Agriculture, Forestry and Fisheries. He has served in his present post since 2008. Nishio's published works include co-authoring *Clinical Plant Science (Yokendo)* and other essays related to diagnosis technologies for phytopathogens. At present, Prof. Nishio is conducting research into clinical plant science, the epidemiology of plant viral disease, damage analysis, etc.

Takeshi Nishio

The Dream of Agro-Innovation: Agriculture as the Ultimate Knowledge Industry

From ancient times, Japan’s agriculture, forestry, and fisheries industry has taken advantage of Japan’s ample natural environment, cultivating a unique culture in the process. Japan’s agricultural industry has played the important role of providing a stable source of food and land stewardship. Today, however, a shrinking workforce, an aging population, rural depopulation, and the abandonment of productive land have all progressed to an alarming degree. Meanwhile, low-cost agricultural products, free trade, and other international developments have led to stagnation in Japan’s agricultural goods prices, placing survival of Japan’s agriculture industry at a crucial juncture.

Prof. Takeshi Nishio believes that agro-innovation is what will break through this deadlock. Says Nishio, “I believe Japan has an untapped capacity equivalent to that of any nation in the world. Over the past few years, we’ve started to see large-scale, high-profit corporate agriculture management, as well as increased exports of high-quality fruits.”

Nishio continues, “Coincidentally, the global food market is expected to double over the next 10 years, bringing an unprecedented level of momentum behind changing lifestyles worldwide and a global interest in Japanese food in particular. Right now, we are looking at a prime opportunity to reform Japan’s agriculture, forestry, and fisheries industry and to venture out into the global markets. It is our chance to transition Japan’s agriculture to one of growth, profitability, and attractiveness as a career choice.”

Prof. Nishio goes on to speak about an experience that has stayed with him for more than a decade. “When I worked for the government overseeing plant protection, I traveled to Europe to observe farms and production there. My eyes were opened by the scale and profitability of these farms, not to mention the lifestyles of the farmers themselves. Of all those experiences, one in New Zealand has stayed with me all this time. There was a former bank president who quit the world of finance and started a career in horticulture. He told me, ‘Of all the industries, agriculture is the ultimate knowledge industry.’ He said, ‘Agriculture management involves more than just production technology. One has to understand current events, international market trends, meteorological science, and also be able to analyze data from a range of perspectives.’ This man showed me that there was no career as fascinating as agriculture. Since then, my dream has been to develop Japan’s agriculture into a knowledge industry, creating an attractive career option for our young people.”

Nishio also relates that it will take large-scale, high-profit, high-quality agricultural products to make this dream a reality. What exactly is this agro-innovation that Nishio espouses?

Smarter Agriculture to Cut Rice Cultivation Labor by Half and Increase Tomato Productivity by 50 percent

The three pillars of this next-generation agriculture program promoted by the SIP are (1) Smart agriculture; (2) new, innovative products through breeding and plant protection technology development; and (3) new value through new functionality. Nishio has set ambitious goals in each of these areas.

Take smart agriculture, for example. Prof. Nishio has set a goal of reducing by half the labor required for rice cultivation, as well as a 40 percent reduction in rice production costs. He believes his team can find these improvements by integrating advancements with agricultural administrative reform. Analysis of data provided by satellites and sensing systems, as well as automated and intelligent production processes, will help reduce the amount of fertilizer used and effort required for water management.

Another goal is to improve productivity by 50 percent for Japanese tomatoes, which are highly marketable around the world. To do this, the program intends to develop new cultivation management technologies based on comprehensive analysis of metabolites (omics data analysis), which will lead to the ability to manipulate yield and quality (composition).

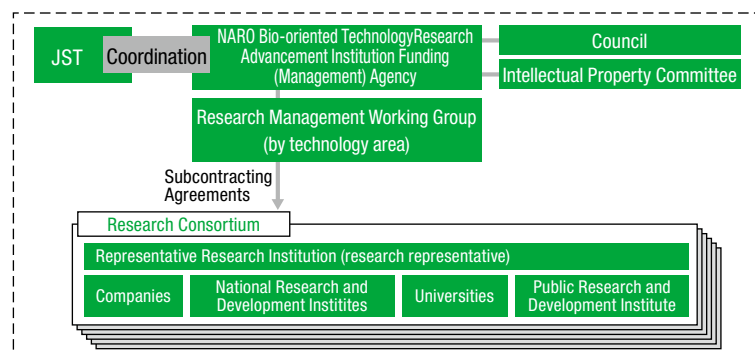
Dr. Nishio also foresees production using greenhouse systems that make use of fine bubble (water containing ultra-fine bubbles that promote plant growth) and other technologies.

Two Innovative Products: Rice Offering 300 percent Yield Gains and Tuna Designed for Easier Breeding

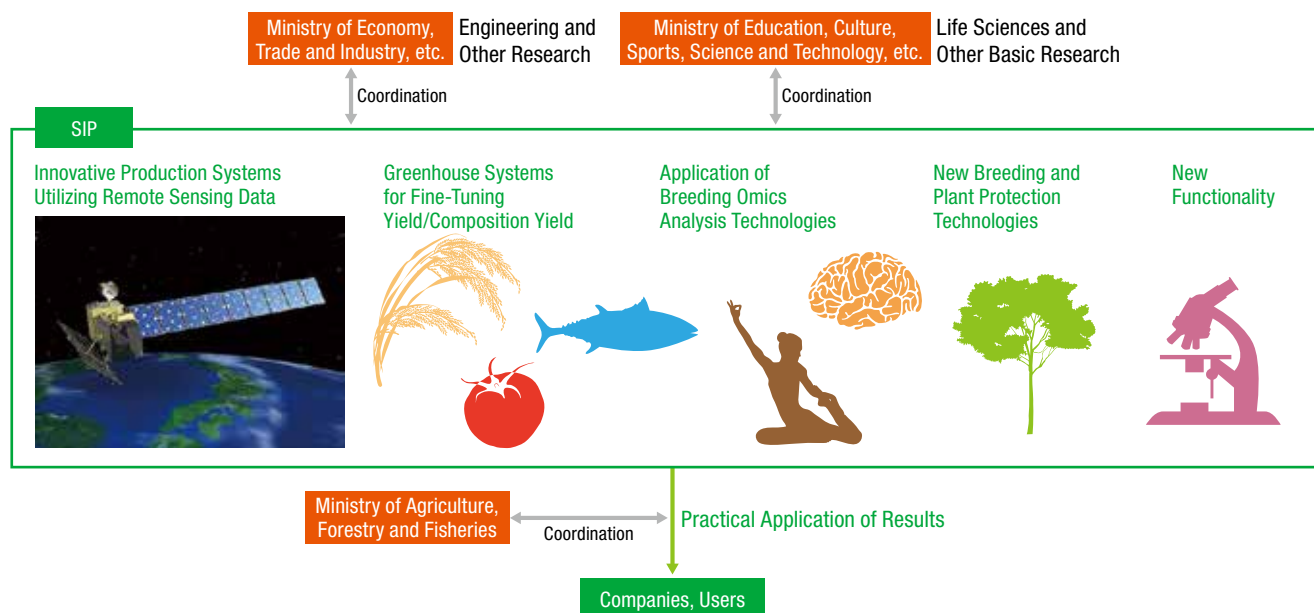
The type of breeding technologies that the SIP is hoping to deliver isn’t the type that requires generation after generation of hybridization. Rather, the program hopes to create breeds that feature characteristics of flavor or transportability using genome editing to shorten the development cycle. It’s not a question of recombining the genes of other organisms, but rather the technology for editing the genome already in place.

Rice is the number one research target under the heading of

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●Implementation Structure



• Relationship between Ministries/Agencies and SIP Next-Generation Agriculture Technology Development

creating disruptive products. The goal here is to increase yields from an average of 0.5 tons per 10 are to 1.5 tons through ultra-high yield varieties produced through new breeding technologies. What comes to mind is the historic “green revolution” in which high-yield wheat played a vital role in addressing the global food crisis. The parent line of this wheat was the Norin 10 Wheat developed here in Japan. Just as America modified this wheat and introduced it to the rest of the world, this program hopes to create a similar revolution with rice, making another contribution to solving global food issues.

The other target for disruptive progress is the Bluefin tuna. As much as 30 percent of a Bluefin tuna population in a breeding pond dies due to tuna-on-tuna collisions. This loss could be reduced by using genome editing to reign in the naturally highly active nature of these fish.

On a different note, Nishio is also talking about making fruit trees more efficient. There’s a saying in Japan that chestnut trees take three years to bear fruit, while persimmons take eight. Nishio hopes to overturn that convention by creating trees that produce fruit within a single year.

New Value through New Functionality: Developing Next-Generation Functional Food and Agricultural Products; Exploiting Lignin and Microalgae

Japan’s population is aging an unprecedented rate. Soon, Japan will be the oldest country in the world in terms of the age of its citizens. Accordingly, the SIP has chosen to focus on brain function and physical locomotion—two areas that greatly affect the quality of life of our senior citizens. This program intends to engage in the research and development of functional foods and agricultural products to use in synergy with sports and exercise. This program will also integrate chrononutrition and develop instruments for measuring improvements in actual situations.

Through focused research and development over the next five years, this SIP program aims to develop at least 10 next-generation functional foods and agricultural products. One target to create new

value through new functionality is lignin. Lignin is an extremely underused resource, usually thrown out as a byproduct of extracting cellulose from wood. This substance could be used to produce plastic materials with qualities not capable through oil synthesis. Microalgae contains EPA, DHA, and other promising components for human health. Progress in lignin and microalgae research could lead to new forestry industries and algae use (produced through water-based versions of plant factories), revitalizing Japan’s outlying mountainous regions and fishing villages.

Making Agriculture an Attractive Career Choice through Agro-Innovation

This kind of agro-innovation requires a combination of technology and expert knowledge from a range of fields. Says Prof. Nishio, “The Ministry of Agriculture, Forestry, and Fisheries tends to avoid joint research with other ministries and agencies, focusing on the more pressing, short-term issues. In contrast, the SIP welcomes the cooperation of any related ministry or agency, creating channels for research and development into Japan’s agriculture, forestry, and fisheries industry.”

In fact, the SIP is an ideal forum for bringing together expert knowledge from disparate fields. Working together with the private sector, this program will produce results that form the basis of products meeting the needs of markets and consumers. Further, these results are expected to be used in real-world agriculture, forestry, and fisheries applications, contributing to new, highly profitable business models. The hope is that these results ultimately find their way to technologies and products adopted throughout the world.

A key for accomplishing these goals is to coordinate structural reform and regulatory reform for successful commercialization, while exercising proper intellectual property management at the same time. “The synergy between agricultural policy and research results will plant the seeds to transform agriculture into an attractive career option for our young people,” says a smiling Nishio.

Research and Development Topics

1 Develop smart agriculture

Use and analyze data from satellite-based remote sensing and other sources. Save resources through automated and intelligent agriculture processes; develop production systems leading to higher-quality agricultural products.

2 Create disruptive products

Develop technologies for new ultra-high yield rice plants (300 percent greater than current levels), Bluefin tuna designed for more efficient cultivation, trees that bear fruit within one year, agriculture that doesn't rely on a singular synthetic agricultural chemical, and other new breeding/plant protection technologies.

3 Offer new value through new functions

Develop effective next-generation functional food and agricultural products to offer super-aged societies longer, healthier lives through more active brain and physical locomotion functions. Engage in developing advanced uses for unused forest and marine resources.

Exit Strategies

✓ Practical farmland adoption of technologies linked to structural reform

Promote large-scale consolidation of farmland; integrate and roll out technologies for smarter agriculture practices. Promote the agriculture, forestry, and fisheries industry as a high-growth, high-income industry.

✓ Products tailored to market and consumer needs through public-private cooperation

Establish a structure for early stage participation and cooperation by private sector companies involved in food, seedlings, equipment, data, the sports industry, etc. Conduct globally strategic research and development, promoting the wider adoption of results.

✓ Wider adoption and new business models from the viewpoint of the technology user

Conduct research and development together with forward-thinking farmers, regional public testing grounds, breeders, and cultivation researchers. Create business models clearly stating the new technologies and results.

✓ Intellectual property management, etc. for global technology rollout

Engage in more technology export and overseas consulting businesses. Engage in a public relations strategy that clearly shows Japan's role in technology cooperation with developing countries.

✓ Initiatives tied to structural and regulatory reforms

Structural reform toward farmland consolidation and regulatory handling of new breeding technologies; pursue technological development tied to regulations and systems related to international harmonization, CODEX and other international standards, etc.

Promote agriculture as a knowledge industry for the benefit of workers, serving as the launching pad for specific goals and dreams.

Reinvent the agriculture, forestry, and fisheries industry as a growth industry by developing products made from advanced technologies from a broad range of fields.

