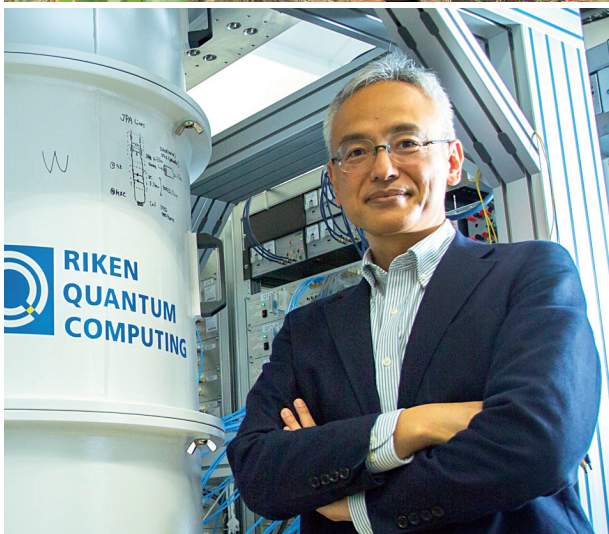


KIZUNA

Summer
2022

Linking Japan and the World



Science & Technology/
Japan and Africa



JAPANGOV
THE GOVERNMENT OF JAPAN



Welcome to KIZUNA, the official magazine of the Government of Japan.

This bold work of calligraphy is 絆 (*kizuna*) written in Japanese. *Kizuna* means the enduring bonds between people—close relationships forged through mutual trust and support.

Originally describing the rope used to tether domestic animals such as horses and dogs, the meaning of *kizuna* has evolved over the years. A passage in *The Tale of the Heike*, compiled in the 13th century, uses the term to refer to the bonds of love between a father and his children. More recently, *kizuna* has gone beyond bonds tying together family and close acquaintances; it is now used in a broader sense of human ties and connections. Of particular note is the *kizuna* born among people during natural calamities, which fosters feelings of solidarity and serves as the underlying strength to overcome hardships.

Similarly, the *kizuna* cultivated among the countries of the world has the power to deepen cooperation for a better future. By reporting on a wide variety of topics concerning Japan, we hope that this magazine will provide opportunities for Japan and the rest of the world to connect and build strong *kizuna*.



KANAZAWA SHOKO
Calligraphy Artist

Born in Tokyo in 1985, she started learning calligraphy from her mother when she was five years old. One of the notable young calligraphers of today, her solo exhibitions have been held throughout the world, in cities such as New York, Singapore, and Prague. She was selected as one of the official poster artists for Tokyo 2020.

CONTENTS

JAPAN AND AFRICA

- 04 Toward TICAD VIII:
Raising Awareness of the Africa-Japan Link
 - 06 Japan-Tunisia Academic Exchanges Sow Seeds
of Business
 - 08 Generating New Value in Africa,
a Captivating Land
 - 10 The Freedom of Reading a Visually Impaired Man
Gained in Japan
-

PORTRAITS OF JAPAN

- 12 Coolness and Sweetness of Japanese Summer
 - 14 50th Reversion Anniversary:
Okinawa's Sustainable Tourism Development and Beyond
 - 16 Sado Island Gold Mines:
A Precious Heritage for Japan and the World
-

SCIENCE & TECHNOLOGY

- 18 Integrated Innovation Strategy 2022:
Making Great Strides Toward Society 5.0
- 20 Touching the Cutting Edge of Quantum Technology
in the Homeland of the Superconducting Qubit
- 22 Creating an Innovation Ecosystem in Okinawa
- 24 The Day When Man-Made Shooting Stars Will Shine
in the Sky
- 26 Making a Big Leap in Magnet Innovation
- 28 Go Together, Go Far:
A Grand Space-Avatar Dream Fulfilled by Open Innovation
- 30 The Impact of AI: Anyone Can Be a Skilled Farmer

KIZUNA
Summer 2022

COVER

Top Left: OKAJIMA Lena, founder of Ale, which is developing man-made shooting stars.

Top Right: MIYASHITA Fumiko is supporting organic agriculture and managing a Japanese restaurant in Uganda. ATSUSHI SHIBUYA

Bottom Left: MISIA, a Japanese singer, visited Zambia in 2019. GENERAL

INCORPORATED FOUNDATION MUDEF
Bottom Right: Dr. NAKAMURA Yasunobu is the director of the RIKEN Center for Quantum Computing.



During MISIA's 2019 trip to Zambia, she visited an orphanage where former street children live and an elementary school in a refugee camp.
GENERAL INCORPORATED FOUNDATION MUDEF

TOWARD TICAD VIII: RAISING AWARENESS OF THE AFRICA-JAPAN LINK

For many years, the singer MISIA has been involved in aid work for Africa. Since 1993, she has twice served as Honorary Ambassador at the Tokyo International Conference on African Development (TICAD), which is gaining significance as an international conference spearheaded by the Government of Japan to address Africa's development issues. What has been inspiring MISIA to visit Africa and provide support all this time?

“What a wonderful place!”

That was the first impression Japanese singer MISIA had when she visited Kenya for the first time, in 2007. It has a pleasant climate and plenty of nature, culture, tradition, and music. As soon as she exited the airport, she was captivated by the vast adjacent national park, dotted with giraffes strutting around. On the other hand, the city was

so developed that her simplistic image of Africa as a place of widespread hunger and disease was immediately erased.

From a young age, MISIA had known of Africa's poverty-related problems through music. Moreover, because the roots of the soul music that influenced her lay in Africa, she developed a natural interest in the continent. After she joined the White Band Project—a global

poverty-eradication campaign—she took the advice of U2 singer Bono, who was already actively involved in aid for Africa, to visit the continent for herself and see what it had to show to her. Encouraged by Bono, she decided to set off, with Kenya as a first port of call.

In Kenya, she had contact with many people through her visit to an elementary school in



Left: TICAD VII in Yokohama, Japan in August 2019. There were over 10,000 participants, including 42 heads of state from 53 African countries, those from 52 development partner countries, 108 international and regional institutions, and the private sector, and other members of civil society such as those working at NGOs. Discussions centered on promoting business. AFP/AFLO
 Right: MISIA was an honorary ambassador at TICAD VII. The photo shows her inauguration speech.



Kibera, which is said to be one of Africa's largest slums, and places such as Maasai village. She was surprised to see so many facets to a single country, and she wanted to show the world this real Africa, including its wonderful attractions.

So, while first learning about Africa herself, she started to introduce the continent to the people of Japan through her music. Simultaneously, she began providing educational support to the children there. Since 2010, she has been working with the general incorporated association "mudef," whose various support includes funds for operating schools, scholarships, textbooks and other school supplies, sanitary goods for schoolgirls, school meals, and the funds necessary to participate in music competitions. She also created a picture book, "Leona with the Heart Mark," which tells the story of Leona, a lioness with a heart symbol on her forehead. The profits from this picture book, which captures the people whom MISIA met in Africa and the lessons she learned there, are also used to support the education of

African children.

Due to such activities over the years, MISIA has twice served as an Honorary Ambassador at TICAD, which is organized by the Government of Japan. In addition to African countries, TICAD participants include international organizations involved with development, partner countries, Asian countries, and private companies. The conference serves as a platform to discuss how to move forward on Africa-led development. TICAD VIII will be held in Tunisia this August. MISIA says, "I believe that learning about each other and taking action together fosters peace in our hearts. I hope that joining forces at TICAD to work on Africa's development will also lead to world peace."

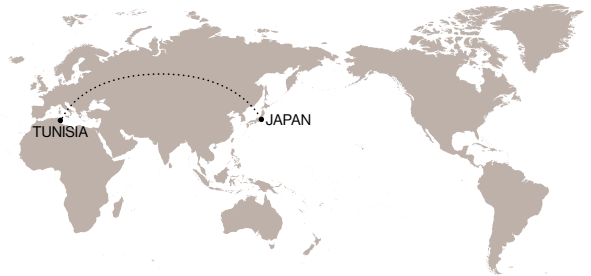
She continues, "Japan and Africa's support of each other exists in many different forms, such as food and resources. Even if you don't go to Africa for yourself, you can get a lot of information through the Internet. When I give talks at Japanese universities, I sense that there is an increasing number of students now who are interested

in Africa compared with when I first became involved in aid work. By sharing my knowledge and experience, I want these students to feel the connection between Japan, Africa, and the rest of the world more deeply than ever before. I want people to make their daily choices knowing that we live in support of each other. The fastest way to do this would be to become friends. I dream of a wonderful future where everyone has one or more friend or acquaintance from the more than 50 countries of the African continent. I wish to serve as a bridge, using the power of music to connect people to each other." ●

MISIA sang the national anthem of Japan at the Opening Ceremony for the Olympic Games Tokyo 2020, which were held in 2021. She pursues her career in music based on the saying she learned in Africa, "where there is music, there is no fighting." THE MAINICHI NEWSPAPERS/AFLO



JAPAN-TUNISIA ACADEMIC EXCHANGES SOW SEEDS OF BUSINESS



For more than two decades, Japan and Tunisia have engaged in academic exchanges. At a technology park that opened in Tunisia with Japan's support, a new business collaboration is budding among industry, government, and academia through research into food and medicinal bioresources.

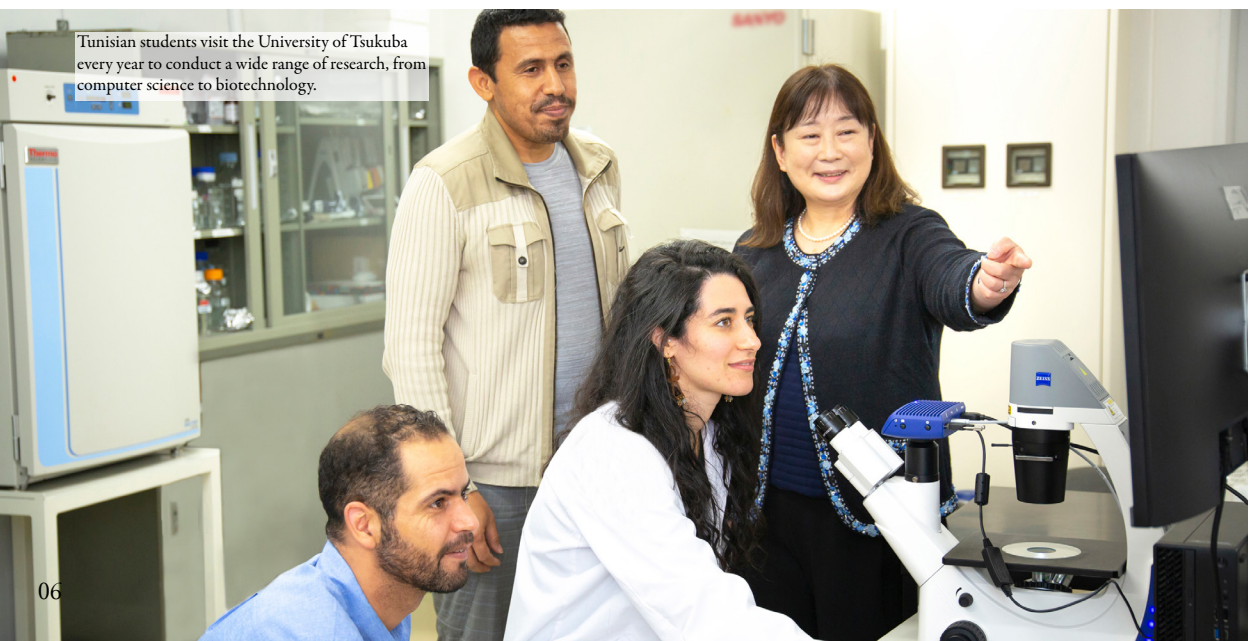
Olives have a reputation as a healthy food, as they contain polyphenol, which can reduce the risk of cancer and arteriosclerosis. But did you know that the olives grown in Tunisia, one of the world's leading producers of the fruit, contain 10 to 20 times as much polyphenol as those from elsewhere around the Mediterranean? Many years of academic exchanges between that country and Japan have helped uncover evidence of the functional components of Tunisian olives.

Located in northern Africa and facing the Mediterranean Sea to the northeast, Tunisia is a crossroads of Mediterranean, Middle Eastern, and African civilizations, making it a treasure trove for researchers in fields ranging from the humanities and

social sciences to natural science. To advance various types of research, Japan and Tunisia have engaged in academic exchanges for more than two decades. The University of Tsukuba in Japan was particularly quick to become involved in Tunisia, initiating exchanges in the late 1990s. In 2004, it established the Alliance for Research on the Mediterranean and North Africa (ARENA), and in 2006, opened its first overseas office in the country's capital of Tunis. The university has thus facilitated organic collaboration connecting possibilities for Tunisia with Japanese science and technology.

ISODA Hiroko, an ARENA professor, is linked by fate to Tunisia. A leading researcher into the medicinal bioresources of North Africa, she has

Tunisian students visit the University of Tsukuba every year to conduct a wide range of research, from computer science to biotechnology.





Professor ISODA Hiroko of the University of Tsukuba's ARENA said, "I love Tunisia. It is such a receptive country." She added, "The Tunisian researchers are adaptable and highly motivated. I have great respect for them."

visited the country over 100 times already and has analyzed the functional components of such plants as Tunisian olives and rosemary. Professor Isoda was the one who identified the aforementioned functional components of olives. The Science and Technology Research Partnership for Sustainable Development (SATREPS)—the Japanese government program that promotes joint research between developing countries and Japan—selected her to prepare a bioresource database for a joint research project with Tunisia. She said that her team has already collected evidence showing that some 100 of the approximately 900 types of plant components have the potential for commercial use.

This research is also being conducted at the Borj Cedria Science and Technology Park in Tunisia, which was built with support from the Japan International Cooperation Agency (JICA) in an ODA loan project. Located on the outskirts of Tunis, the technology park has garnered attention for identifying the seeds of new businesses through collaborations among industry, government, and academia in the fields of biotechnology, water resources, and renewable energy. Professor Isoda said, "We are trying to turn our research into economic benefits, and I hope that the two countries will enjoy a win-win relationship."

Mohamed Moncef Harrabi, the former director of the National Agronomic Institute of Tunisia (INAT) and former head of the technology park, said, "Despite having limited experience with Japan, I was convinced of the country's high level of technology



Professor Mohamed Moncef Harrabi, former head of the technology park, has contributed to academic exchanges in agricultural science between the two countries for more than two decades.



Top: The Biotechnology Center, where Professor Isoda and Tunisian researchers cooperate on bioresources research.

Bottom: With Japanese support, the Borj Cedria Science and Technology Park has state-of-the-art equipment enabling it to conduct research at the same level as Japan's.

and science, which led to my decision to encourage exchanges. Academic exchanges with Professor Isoda and others from Japan have had a big impact at many levels in Tunisia, such as the transfer of technology."

Academic exchanges have also been focused on developing professionals in technology. So far, almost 100 Tunisian students have studied in Japan, pursuing collaborative research. What worries Professor Isoda, however, is that the students, once return to Tunisia, have few employment opportunities available to them to apply the research skills that they acquired in Japan. To address the situation, she established a company last year in Tsukuba that supports drug discovery, thereby creating places for such students to thrive. She plans to merge the venture eventually with a local company in Tunisia and promote research and development there. Research into functional bioresources is one area where Japan leads globally, and she aims to create significant added value through local discoveries in Tunisia that will lead to related production being launched there.

Professor Isoda said, "With the current attention on well-being, my hope is that the talented students who have studied in Japan will connect their research to business and become professionals who demonstrate leadership around the world." ●

GENERATING NEW VALUE IN AFRICA

A CAPTIVATING LAND



A Japanese woman goes into business in Uganda, managing a Japanese restaurant and supporting organic agriculture. Her goal is to generate new value through business and contribute to African development. Her source of energy? The positive attitude of Africans who see hope for the future.



Tank Hill Park made use of local timber to create an open space. In 2020, the building was awarded the Good Design Gold Award (Minister of Economy, Trade and Industry Award) by the Japan Institute of Design Promotion as an outstanding example of Japanese design.
TIMOTHY LATIM

“I was captivated by Africa,” says MIYASHITA Fumiko. She is talking to us in a pleasant, open space within a Ugandan café that is part of a Japanese restaurant called Yamasen, managed by Miyashita herself. In addition to managing the restaurant, she is also a co-director of Cots Cots Ltd., a company that deals with agricultural products and operates a commercial facility in Kampala, the capital of Uganda.

Miyashita’s fascination with Africa began in her college years. As a cultural anthropology major, she was intensely drawn to African culture, which was so different from her own. She had hoped to become a scholar to probe the depths of the land that had captivated her. In 2011, however, just as she was about to begin her graduate studies, the Great East Japan Earthquake occurred on March 11, changing her outlook. Driven by a need to connect with society, she joined a venture company that supports sustainable farming. She worked for the company

while continuing her studies, and started traveling to and from Uganda as part of the firm’s efforts to expand its business to developing countries. In 2014, she relocated to that country as the company’s overseas representative.

She met several fellow Japanese people living in Kampala, and they discussed the possibility of launching a Japanese-style restaurant there. Around that time, her partner—who managed a restaurant as a chef in Kyoto—decided that he, too, would relocate to Uganda. In 2017, Miyashita teamed up with others and co-founded Cots Cots Ltd.

The name of the company—Cots Cots—stems from the Japanese term *kotsu-kotsu*, which means “to work diligently, step by step.” Miyashita took over the business of the company she formerly worked for—namely supporting organic farmers and distributing and exporting their products—and is making steady efforts to develop it in a way that will engender more value. The expression *kotsu-kotsu* doesn’t necessarily mean that she doesn’t take risks though. She thought that scale would be an important factor if she hoped to popularize Japanese cuisine and enable the company to succeed as a business. The company procured the necessary funds and, in 2018, established a commercial facility named Tank Hill Park. A focus on good design resulted in an eye-catching piece of architecture that truly stands out. In the center of the facility is Yamasen, a restaurant specializing in Japanese cuisine. Forty of its staff are local employees.

Running the business has not been easy. When

Yamasen is the first Japanese restaurant to have a Japanese chef in Kampala, the capital of Uganda. Initially, guests were mainly foreigners, but now locals also visit and enjoy its food.
TIMOTHY LATIM



Uganda closed its borders in March 2020 to prevent the spread of COVID-19, 80% of foreign residents—core restaurant clients—left the country. An unexpected but happy development, however, was that local residents began to visit the facility more regularly than previously, possibly because they were no longer shy about frequenting a place that mainly catered to foreigners. The restaurant has been revising its price list and menu to fit better the needs and tastes of locals, who are more conservative about what they eat. “One popular item is cassava, simmered in *dashi* (broth) and then fried, similar to the way Japanese potatoes are prepared in Kyoto. Foreigners are also coming back, and the restaurant is now a place for all kinds of people to come together.”



Local cassava, simmered in *dashi* and fried, is a popular item on Yamasen’s menu.

Miyashita admits that there were troubles along the way, but laughs and says she has forgotten them all. “Ugandans are such a positive people. I’ve been saved many times by the way they can let go of past issues. The population is growing and the country has momentum, with people thinking that tomorrow will be better than today and that the future will be even better still. This positivity is the engine that

propels me forward.”

Cots Cots is also busy developing new business possibilities. The company collaborates with Miyagi Prefecture’s Fisherman Japan, an association of young fishermen, to demonstrate the possibility of creating a value chain with pre-processed, high-value-added marine products from neighboring Tanzania. It is also working with Japanese trading firms that want to build responsible ties with local producers and help them to procure and distribute sustainably grown cotton.

Captivated by Africa, Miyashita is generating value, step by step, thereby contributing to the continent’s development. That is her mission, and she follows her path with light but determined steps. ●

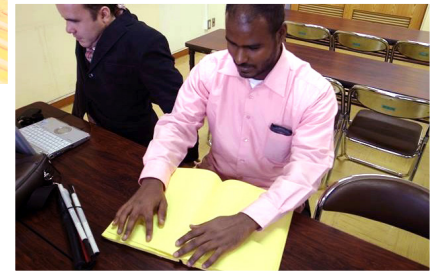


Cots Cots Ltd. is committed to organic farming, using its products at Yamasen and exporting chili peppers and shea butter to Japan.
ATSUSHI SHIBUYA

MIYASHITA FUMIKO
MIYASHITA Fumiko joined Saka No Tochu Co., Ltd., a venture company that advocates environmentally friendly farming, while a student at the Kyoto University Graduate School. In 2012, she began to deal with agricultural production and distribution in Uganda and relocated there as the firm’s overseas representative in 2014. In 2017, she co-founded Cots Cots Ltd.



Mohamed Omer Abdin notes that Japanese cities have extensive mass-transit systems and tactile paving is widespread. Furthermore, orientation and mobility training, including walking with a white cane, is widely available. The existence of appropriate facilities and assistance for the visually impaired in Japan was life-changing for him after leaving Sudan.

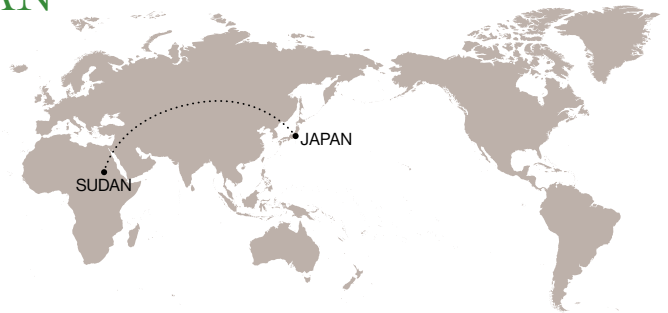


To defend the right to education for visually impaired children in Sudan, Abdin works through an NPO that provides braille textbooks. The man reading a braille textbook in the photo is CAPEDS Board Member Murtada Eljailani.

THE FREEDOM OF READING

A VISUALLY IMPAIRED MAN GAINED IN JAPAN

Leveraging experience gained from living in Japan, a visually impaired man from Sudan has been working energetically to help those similarly impaired. What is the “freedom of reading” for him? Discover how he has been endeavoring to share that freedom with his fellow Sudanese back home.



“Visual impairment equates to information impairment. To be active members of society, the visually impaired need information to be accessible.” This idea has driven a Sudanese man in Japan to support those afflicted in this way. His name is Mohamed Omer Abdin. He is almost completely blind.

How did Abdin become involved in those support activities in a foreign land so far from home? To understand this, we need to know something about the “freedom of reading” he obtained in Japan.

In Sudan, where Abdin lived until 1998, braille and schools for the blind were few and far

between. Therefore, he had to study by having his classmates read his textbooks out loud to him. Even after admission to a renowned university, the lack of information accessibility within the learning environment and closure of the university due to the deteriorating political



Left: Abdin plays blind soccer, which he took up at university. He met FUKUCHI Kentaro, with whom he started up the NPO, through the sport. H.WANIBE/IBFA
 Right: Abdin participating in a meeting in his office at Santen Pharmaceutical. Santen has a clear vision to realize an inclusive society in which people with and without visual impairment play equal roles.

situation in his own country made Abdin uncomfortable at times. It was then that he discovered that the International Association for the Visually Impaired, located in Japan, was recruiting blind students to study in the country. “Japan seems to have an appropriate learning environment for the visually impaired,” thought Abdin, and leapt at the chance.

Upon arrival in Japan, Abdin found a wealth of books in braille and works of literature as audiobooks that he could borrow from the library. This environment allowed him to immerse himself in reading—something that had previously been all but impossible for him. Once Abdin learned how to use narration software on a computer, his horizons expanded further still. He no longer needed someone to read aloud to him, making this a revolutionary event in his life. This is how he gained the “freedom of reading.”

“How might my life have been different if I’d known braille and how to use a computer during my schooldays?” Abdin came to wonder what he could do for other visually impaired people back in Sudan, so consequently, in 2008, he and his companions in Japan started up an NPO, the Committee for Assisting and

Promoting Education for the Disabled in Sudan (CAPEDS). The NPO has been carrying out a variety of activities in Sudan, including installing braille printers and providing braille and computer lessons. These activities have made braille textbooks, which previously could not be produced, available in local Sudanese communities. One of the computer-lesson students, Musharraf Omer, went on to become a computer programmer and develop Bookworm, a screen reader software for the visually impaired. In addition to providing narration for websites and documents in various formats, Bookworm comes with many convenient features such as bookmarks and notes but is simple and accessible. Seeing potential in Bookworm, CAPEDS provides support for the software, expecting it to enrich the lives of visually impaired readers around the world.

Since 2020, Abdin has also been involved in a CSR project at a Japanese company, Santen

Pharmaceutical, which specializes in ophthalmic treatment, to support the visually impaired in Japan. The project holds job-search seminars for the visually impaired and supports startups to create services tailored to their needs.

“Japan has accumulated a great deal of knowledge concerning how to assist the disabled. The reason I am in this country is to spread that knowledge to every corner of the world. I wish to help connect Japan and Sudan. At the same time, I want to contribute to the acquisition of the right to study and work for the visually impaired in Sudan and beyond.” Abdin is taking on challenges to help the world’s visually impaired obtain the “freedom of reading” and create a future where they can fully participate in society. ●

MOHAMED OMER ABDIN

Born in Khartoum, the Sudanese capital, in 1978. Currently works for Santen Pharmaceutical, heads the Committee for Assisting and Promoting Education for the Disabled in Sudan (CAPEDS), conducts research on African politics, and writes essays.





MORNING GLORY

At dawn in summer, morning glories waiting for the day to begin open their fresh blossoms. Enthusiastically cultivated in Japan from the 17th to 19th centuries, numerous species were created with various colors and shapes. Collectively referred to as “Japanese morning glory,” they are still widely loved today. Trellises of the flowers form by vines that cling to supports as they grow upwards—a way to live wisely by avoiding sunbeams on hot summer days. The botanical “green curtains” of the olden days are still alive and well in the modern era.

COOLNESS AND SWEETNESS

OF JAPANESE SUMMER

Vibrant summer in Japan delights people in a variety of ways. Inherited wisdom to beat the heat creates refreshing scenery, and Japanese summer delicacies have been attracting fans across the seas.



AFLO



WHITE PEACH

Japanese fruits are increasingly appreciated abroad. Among them—white peaches, which ripen with the approach of summer—have a delicate flavor, juiciness, sweetness, and elegant aroma, making them popular as gifts. One major producing region, Fukushima, vigorously promotes the development of cultivars such as “Akatsuki,” distinguished by its large size and fleshiness, through the establishment of overseas markets.

During the Olympic and Paralympic Games Tokyo 2020, Fukushima peaches created a buzz on social networks when athletes posted rave reviews after tasting them.

SHAVED ICE

Cooling the eye and chilling the tongue, shaved ice is a popular summer treat. Usually topped with colorful syrups, shaved ice in Japan is often flavored with *matcha* (powdered green tea), giving it a lovely green tint with a faintly bitter taste that is superb. As people become ever more health conscious, a wide variety of Japanese tea is being welcomed around the world, and exports of *matcha* from Japan continue to grow. Japanese culture, at times taking surprisingly creative forms, continues to find an appreciative audience abroad, signaling a heritage with a good future.



50TH REVERSION ANNIVERSARY: OKINAWA'S SUSTAINABLE TOURISM DEVELOPMENT AND BEYOND



May 2022 marks a full half century since the reversion of Okinawa Prefecture to Japan after 27 years under U.S. administrative control. While confronting many difficulties, the prefecture has capitalized on its unique local features to transform itself into a resort destination welcoming 10 million visitors a year. Take a closer look at the trajectory followed by Okinawa and the vision it intends to pursue.

“We were just glad we would no longer need passports to travel to and from the mainland. There was a great sense of expectation among the younger generation, myself included, 50 years ago,” recalls KAWAKAMI Yoshihisa, chief director of the Okinawa Development Finance Corporation, as he looks back on May 15, 1972, the day on which Okinawa Prefecture, under U.S. administrative control since the end of World War II, was returned to Japan. “But I think many of us residents were torn between feelings of hope and concern.”

Comprising more than 160 islands at the southwestern edge of Japan, Okinawa today has grown into one of the country’s leading resort destinations. Yet at the time of the reversion, the circumstances surrounding Okinawa were quite severe in various areas: income

levels were less than 60% of the national average; various infrastructure development was falling behind; and disparities existed with mainland Japan in such areas as education, health care, and welfare. In addition to the confusion caused by the introduction of a new administrative and economic system, including the dollar-to-yen shift, the prefecture was also hit by the “Nixon shock” and the first oil crisis, the effects of which Japan as a whole was suffering.

Even now, Okinawa bears the heavy burden of housing—within the prefecture’s own limited land space—more than 70% of the total exclusive-use U.S. Forces Japan (USFJ) facilities and areas in the whole country. Despite such difficult circumstances, the prefecture underwent a stunning transformation to

become “tourism islands” visited by 10 million people a year. It has also striven to leverage its local characteristics and has succeeded in developing new industries besides tourism, including IT and global logistics, as well as having established OIST, an interdisciplinary graduate school offering world-class standards of research and education. Reflecting on the past 50 years, Kawakami says, “Okinawa has experienced a remarkable transformation unimaginable at the time of reversion.”

Expected to provide a competitive edge to the prefecture even as a remote island area, tourism has been positioned as a key industry for Okinawa ever since the first days of reversion, with work advancing on essential infrastructure—from transport to accommodation. The world’s first international ocean-themed exposition was held in Okinawa in 1975, helping to cement the prefecture’s image as a beach resort. Coupled with the Japanese postwar economic miracle and airline travel campaigns, the islands saw first an increase in domestic travelers. By 1991, the annual number of visitors had reached 3 million, a large increase from the 450,000 at the time of

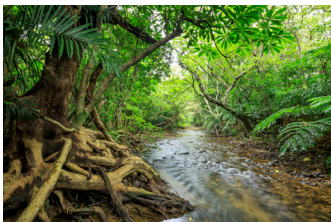
Okinawa’s greatest tourism resource is its beautiful ocean, which is also a treasure trove of diverse and rare marine creatures. Reportedly more than half of all coral species in the world live in Okinawa’s vast waters, which spread approximately 1,000 km from east to west. AFLO



Left: The signing ceremony for the Okinawa Reversion Agreement in June 1971. It was carried out simultaneously in Tokyo and Washington, D.C., and was broadcast live via satellite. Center: Okinawa on May 15, 1972, the day of its reversion to Japan. Displayed above the road is a banner celebrating the occasion. Under U.S. administrative control and for a while thereafter, cars drove on the right side of the road, but from 1978 onward they switched to the left in accordance with national traffic rules. Changing everything from traffic signals to signs and road markings was an enormous undertaking. Right: There are 31 USFJ facilities and areas in Okinawa Prefecture alone, including Camp Hansen. THE MAINICHI NEWSPAPERS/ AFLO (left photo), THE YOMIURI SHIMBUN/AFLO (center), THE ASAHI SHIMBUN COMPANY/JIJI PRESS PHOTO (right)

reversion. From 2000, the islands focused on further building up their tourism resources, including their inscription on the World Heritage List, aiming at attracting visitors from overseas. As a result, as many as 18 air routes from other parts of Asia were established, and the number of travelers exceeded 10 million in fiscal 2018.

With its growth as a tourist destination, Okinawa has been confronted by new challenges, including overtourism—with an accompanying excessive dependence on tourism income—as well as



The northern part of Okinawa Island and Iriomote Island, often described as the “Galapagos of the East” due to their many endemic species, have been registered as a World Natural Heritage site. AFLO



socioeconomic damage from the COVID-19 pandemic, intensified by plummeting tourist numbers. But these problems have also presented opportunities for the prefecture to reconsider how tourism should be. Now, aiming for sustainable tourism that is friendly to local communities and the environment, Okinawa is promoting initiatives such as eco tours and environmental measures, including the treatment of marine debris, in compliance with the Global Sustainable Tourism Criteria for Destinations, a widely recognized sustainability guideline.

Okinawa is also taking advantage of its unique local characteristics to pursue paths for further development other than tourism. One example is the initiative it is taking toward decarbonization, which includes the application of renewable energy and ocean thermal energy

conversion on remote islands. “What is important in sustainable regional development is for the islands of Okinawa to continue being rich and attractive. We need to take care of nature and firmly pass on our history and traditional culture to following generations,” remarks KAWAKAMI Yoshihisa, chief director of the Okinawa Development Finance Corporation. The corporation was established when Okinawa reverted to Japan, and has been providing funds integral to the national government’s measures for the promotion and development of the prefecture.

conversion on remote islands. “It is crucial to closely watch the trends of the times, such as digital transformation and decarbonization, and determine how to design our region to be more competitive,” notes Kawakami. “There are still many local challenges to overcome, but we want to set our sights on becoming a self-sustaining economy and, eventually, a region that can contribute to Japan and the rest of Asia.”

Okinawa will continue to embrace and build upon its distinctive environment and culture, a strong emphasis of efforts made since the 1972 reversion, and explore new possibilities in these changing times. ●

“What is important in sustainable regional development is for the islands of Okinawa to continue being rich and attractive. We need to take care of nature and firmly pass on our history and traditional culture to following generations,” remarks KAWAKAMI Yoshihisa, chief director of the Okinawa Development Finance Corporation. The corporation was established when Okinawa reverted to Japan, and has been providing funds integral to the national government’s measures for the promotion and development of the prefecture.



The Aikawa-Tsurushi Gold and Silver Mine. The artificial V-shaped crack running through the top of the mountain was dug 74 meters deep and 30 meters across. Experts speculate that during the Edo period, from the early 17th to the mid-19th century, miners extracted some 40 tons of gold.

NISHIYAMA HOICHI

SADO ISLAND

Aikawa-Tsurushi
Gold and Silver Mine

Nishimikawa Placer
Gold Mine

SADO ISLAND GOLD MINES: A PRECIOUS HERITAGE FOR JAPAN AND THE WORLD

The gold mines on Sado Island once made Japan the “land of gold.” With the aim of having them inscribed on the World Heritage List, the Government of Japan has nominated the mines to UNESCO. This nomination has drawn attention to their Outstanding Universal Value (OUV).

Once upon a time, Japan was known in the Western world as the “land of gold.” Gold mining in Japan actually dates back to at least the 8th century, and the country produced about 20% of the world’s gold output in the mid-17th century. The Sado Island Gold Mines, in particular, were central to Japanese gold production for many years. With its OUV, it is anticipated that the site will be inscribed on the

UNESCO World Heritage List.

In June 2022, a symposium was held at the International University of Japan in Niigata Prefecture, where Sado Island is located, to publicize the cultural value of the gold mines. Sado Island, 40 km off the coast of the prefecture and covering 855 km² in the Sea of Japan, has two types of gold deposits. The Nishimikawa area has a placer gold mine where sandy gold is found in the layers

of sediment. The Aikawa-Tsurushi area, on the other hand, has lode deposits where gold lies in the veins that penetrate through the rocks. The different characteristics of these gold mines led to different mining techniques. In Nishimikawa, miners used water

Historical material in the form of picture scrolls depicting a series of gold production processes, from extraction to dressing, smelting, refining, and coin minting. On Sado Island, large quantities of the purest gold in the world were produced entirely by hand, rather than through the mechanized production that was advancing in the world’s mines at the time. SADO CITY



flowing from artificial reservoirs to extract the placer gold, while in Aikawa-Tsurushi, advanced techniques were developed for efficient mining, such as digging drainage or ventilation tunnels separately from the main tunnel.

The two mines were adapted to their different mining methods, not only in regard to their technical systems, but also their production systems. The Nishimikawa Mine had an unspecialized small-scale production system, in contrast to Aikawa-Tsurushi, which had a specialized large-scale production system. In addition, the entire production process from mining to dressing, smelting, refining, and coin minting, was conducted on the island. Barry Gamble, an international World Heritage consultant with a special interest in industrial sites and a panelist at the symposium, pointed out, “It is the gold-mining heritage and the socio-technical systems of the Edo period that make the heritage of Sado Island Gold Mines unparalleled in any other country in the world.” Gamble went on to say, “Organized by the government at the time on a massive scale, Sado Island became the largest gold mine in the world.



Top: This coin was minted on Sado Island around the year 1720. COLBASE
 Right: A traditional performing arts ritual offering prayers to mountain deities so as to discover soft ore containing gold and silver. SADO PERFORMING ARTS ARCHIVE



It was important nationally, to the government, and globally, in terms of the role it played within trade.”

Human resources for the island’s gold production were recruited from all over the country. Their ability to produce gold using unmechanized handicraft methods with a purity of 99.54%, higher than that of Western European gold mines of the same era that used machines and chemicals, was due to the combination and revolutionary development of traditional techniques. Settlements were built near each mine, and these also had different characteristics depending on the mine—a fact that is known thanks to their comprehensive preservation. At the symposium, OKADA Yasuyoshi, president of ICOMOS Japan, the Japanese national committee of the International Council on Monuments and Sites, explained that over 100 colorful picture scrolls depicting the mining processes from extraction to currency production are still in existence. He stated, “These scrolls are among the numerous precious materials that give us

an insight into the gold mines of that time.” Another panelist, MIYATA Ryohei, a metal craft artist and former Commissioner of the Agency for Cultural Affairs, Government of Japan, from Sado Island, noted that more than 30 stages used for Noh, a traditional Japanese performing art, remain on the island. “Cultural values have spread around the island as a matter of course,” he said proudly. On the island, with cultural practices that developed around the mining industry alive to this day, people are able to witness scenes that are largely unchanged from drawings created several hundred years ago.

Today, organizations of landowners and the local community, actively participate in the preservation of the cultural heritage. The Sado Island Gold Mines provide near-complete evidence of the accomplishments of those who lived during the pinnacle of a gold production system that was founded on traditional handicrafts. There is nothing like it anywhere else. It is an exceptional cultural heritage for Japan as well as the world. ●



The International Symposium on the Cultural Value of the “Sado Island Gold Mines” was held in June 2022 at the International University of Japan in Niigata Prefecture. Students from various countries participated in a vibrant Q&A discussion with three panelists.

INTEGRATED INNOVATION STRATEGY 2022

MAKING GREAT STRIDES TOWARD SOCIETY 5.0

Science, technology, and innovation are growing increasingly vital not only for sustaining economic growth, but for finding solutions to social problems and ensuring safety and security. Here are the three pillars of Japan's "Integrated Innovation Strategy 2022," which lays out the direction for such policies and the priority measures to be taken.

As the situation in Ukraine, infectious disease, climate change, and other unpredictable crises and unprecedented social challenges sway the world, developments in science, technology, and innovation have become not only the drivers of economic growth, but also crucial lifelines for countries to solve social problems and ensure the safety and security of their citizens. In the 6th Science, Technology and Innovation Basic Plan, Japan set the goal of reaching

120 trillion yen in R&D investment between the public and private sector over the five years from fiscal 2021, aiming to realize Society 5.0—a model future society proposed by the Japanese government, in which both economic growth and the resolution of social issues can be achieved by making full use of advanced technologies. This June, the Kishida administration released the Integrated Innovation Strategy 2022, which outlines the process for

At the meeting of the Council for Science, Technology and Innovation in June, PM Kishida received an explanation while observing a model of a quantum computer. He expressed his determination to collaborate with other nations and draw focused investment from the public and private sectors to accelerate initiatives for the social implementation and industrialization of quantum technology.



achieving this goal.

The strategy has three fundamental pillars. The first is strengthening research capabilities and developing human resources. Utilizing a 10-trillion-yen University Endowment Fund, long-term support will be provided to realize world-class research universities that generate outstanding results and foster talented individuals who can lead society. Inquisitive minds and critical thinking, essential for the age of rapid technological innovation, will be cultivated via efforts such as enhancing STEAM education—cross-sectional education prioritizing science, technology, engineering, and mathematics, with the addition of the arts—in elementary, middle, and high schools, and providing opportunities to experience high-level pursuits at universities and other institutes for higher learning. Through such initiatives, “knowledge”—a source of innovation and value creation for future generations—will be continuously created.

The second pillar is the strategic promotion of advanced and emerging technology. R&D in a wide range of technologies that can bring about transformational change, such as AI and quantum technology, will be advanced strategically to accelerate their practical application. For AI technology, deep learning is positioned as a priority area since its effective utilization is anticipated in a broad range of fields. Additionally, the creation of digital twins and applications for sustainability will be pursued to allow agile responses to impending crises, such as large-scale earthquakes and increasingly torrential rainfall. Regarding quantum technology, new targets of having 10 million users in Japan by 2030, achieving production on the scale of 50 trillion yen, and creating quantum unicorn startups have been set.

To that end, innovation hubs for industry, academia, and government collaboration at all levels from basic research to social implementation will be strengthened, and utilization of such cutting-edge technologies will be promoted. Moreover, centering on the launch of programs that provide powerful support for such development, bold investment in advanced science and technology will nurture world-leading technologies.

With research capabilities and the seeds of



Society 5.0 refers to the new society that follows the hunting society (Society 1.0), agricultural society (Society 2.0), industrial society (Society 3.0) and information society (Society 4.0). It is defined as “a human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space.” It was first proposed in 2016 by Japan as the future society it should aspire to be. Furthermore, Society 5.0 was redefined in 2021 as “a sustainable and resilient society that protects the safety and security of the people and one that realizes the well-being of individuals.” Key to its realization is the advancement of science, technology, and innovation. Incorporating AI, quantum technology, IoT, and other cutting-edge technologies in all industries and social activities, and creating new value from innovation, will both achieve economic development and find solutions to social problems in parallel.

technology developed through these two pillars, the creation of an innovation ecosystem—the third pillar—will be a game-changer in realizing the future society. By reinforcing initiatives for the advancement of the venture capital market, a stronger mechanism for the continuous birth and growth of startups that lead to innovation will be developed. In addition, public-private R&D investment will be expanded through measures such as R&D tax incentives and the Japanese SBIR (Small Business Innovation Research) program. While leading to new growth, the rewards will be given back to individual citizens and society as a whole in the forms of fulfilling diverse well-being needs and solving social issues.

The integration of these three pillars is essential to realizing Society 5.0. The complex social problems confronting the world today are difficult to overcome through sector-specific technologies and individual policies alone. By enhancing overall policy integration, new value will be created to sustain economic growth and solve global-scale issues, and the fruits of such efforts will be distributed to citizens, society, and the world. Japan will make strong strides toward its goal of becoming a science and technology nation for the new age that will achieve this virtuous cycle of growth and distribution. ●



Dr. NAKAMURA Yasunobu poses alongside RIKEN's superconducting quantum computer. He produced superconducting qubits when he was a researcher at NEC Corporation's Basic Research Laboratories. Dr. Nakamura is now director of RIKEN Center for Quantum Computing and a professor at the University of Tokyo's Department of Applied Physics, Graduate School of Engineering.



The April 29, 1999, edition of *Nature* that published Dr. Nakamura's paper. The cover features an illustration of a superconducting qubit measurement signal. On the left is a superconducting qubit chip.

TOUCHING THE CUTTING EDGE OF QUANTUM TECHNOLOGY IN THE HOMETOWN OF THE SUPERCONDUCTING QUBIT

Quantum computing—once considered a distant dream—is now in the initial stages of becoming a reality. Amid the fierce global competition to develop the technology, the Government of Japan has formulated the Vision of Quantum Future Society in April of this year, and is accelerating R&D in that field. A researcher who paved the way to its practical use with his world-first breakthrough 20 years ago talks about the outlook for quantum technology.

In 1999, a paper published in the journal *Nature* amazed and encouraged researchers around the world, having demonstrated the realistic possibility of creating a working quantum computer for the first time ever. The paper described the world's first successful attempt at developing superconducting quantum bits (qubits), which act as the heart of a quantum computer. Through that breakthrough, the microscopic world of quantum mechanics, normally invisible to the human eye, was realized

on a macro scale in the form of an electrical circuit. The technology's developer, Dr. NAKAMURA Yasunobu, said, "In the laboratory, I witnessed a phenomenon nobody had seen before. It was truly gratifying for a researcher such as myself."

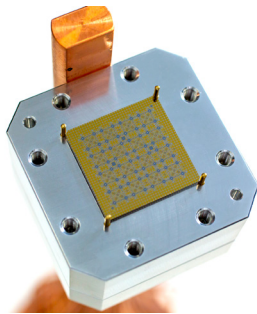
A quantum computer that performs calculations with quantum mechanics could be far more powerful than the latest supercomputer. In recent years, governments around the world have been formulating national strategies and putting effort into developing

the quantum technology. Likewise, the Government of Japan considers quantum computing a core element of the growth strategy under the Kishida administration's New Form of Capitalism.

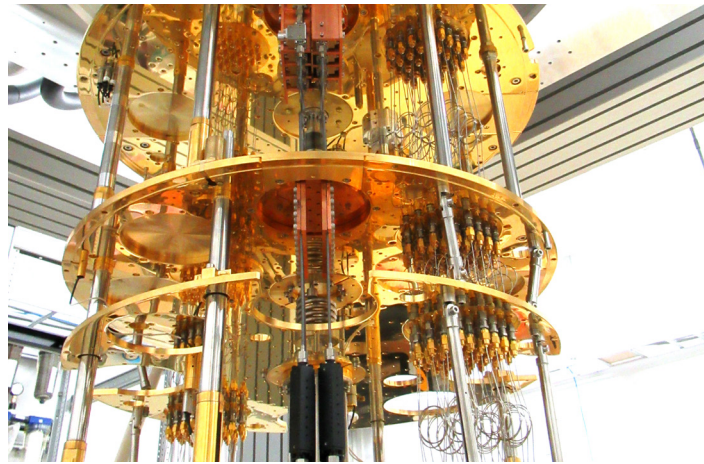
In 2020, the government laid forth the Quantum Technology and Innovation Strategy, and the following year, established eight new R&D centers to facilitate collaboration and accelerate research. Dr. Nakamura is the director of one of these, RIKEN Center for Quantum Computing. The center's work follows a full-stack approach—from hardware to software and from basic science to application—thus covering broad aspects of R&D. He says, “At our current stage, we have produced a prototype, which was unthinkable two decades ago,” and adds, “The progress of humanity's wisdom and technology feels tangible to me.”

In April 2022, the Japanese government formulated a new strategy, named the Vision of Quantum Future Society, that expanded on the initiatives for social innovation through quantum technology from the 2020 strategy. It aims for society's positive evolution by embedding quantum technology throughout social and economic systems, which will create opportunities for industrial growth and a carbon-neutral society, as well as addressing social issues such as those raised by the SDGs.

For several years already, a number of foreign companies have been operating cloud services powered by quantum computing. Japan is also making practical applications in the area a reality, as the government's strategy calls for the country to produce its first domestically manufactured quantum computer by March of next year.



A 64-bit superconducting qubit chip, measuring about 2cm on each side. It is mounted onto a wiring package that connects to the quantum computer.



The inside of the superconducting quantum computer. Superconducting qubits only function in a state of superconductivity, in which electrical resistance disappears. They are stored in a cooling device that produces the superconducting state and reduces errors by lowering the temperature to near absolute zero ($-273.15^{\circ}\text{C} + 0.01^{\circ}\text{C}$). RIKEN CENTER FOR QUANTUM COMPUTING

However, human society is still at the dawn of the quantum computing era. Current quantum computers are limited in what they can do as they cannot churn out accurate calculations, owing to the fact that they produce errors after a certain amount of computation. The eventual goal is a fault-tolerant quantum computer that reduces errors during the computing process, while correcting any new ones that do arise. With researchers across the globe facing an enormous number of challenges, Japan's goal is to produce such a device by 2050.

Dr. Nakamura says that Japan's advantage in quantum computing comes from “consistently and steadily conducting basic research, and accumulating results.” In addition to his development of superconducting qubits, Japan also developed the concept of quantum annealing—one of the principles behind quantum computing—underpinning the country's contribution to basic research on quantum technology. In the future, Japan will accelerate R&D so as to stand shoulder-to-shoulder with the world's leaders in industrializing the technology.

“The new field of quantum technology faces a global challenge—that of developing talent. I would like us to achieve advances in quantum technology and eventually develop a quantum computer by enlarging our circle of collaboration to include people working in different fields, not only in Japan, but also throughout the entire world.” ●

CREATING AN INNOVATION ECOSYSTEM IN OKINAWA

Ranked top by the Nature Index for its renowned research excellence, the Okinawa Institute of Science and Technology Graduate University is giving comprehensive and hands-on support to researchers and early-stage startups to spur economic growth.



In the rolling hills of Onna Village on Okinawa Island, a collection of curved buildings nestles in the subtropical rainforest. It is easy to mistake it for one of the resorts dotting the white-sand beaches nearby. The campus, however, is the Okinawa Institute of Science and Technology Graduate University, known as OIST for short, a unique hub of scientific research and innovation in Japan.

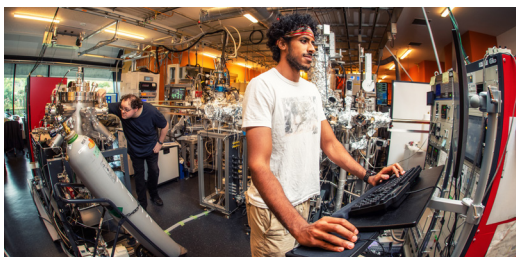
Founded in 2011 with support from the Government of Japan, OIST has two objectives: to help the promotion and self-sustainable development of Okinawa, Japan's southernmost prefecture and to contribute to international science and technology development. To achieve these objectives, OIST will nucleate a knowledge cluster that will catalyze technology transfer in Okinawa. The institution is a university like no other in Japan. Its five-year Ph.D. program in science has been drawing world-class researchers, students, and staff from abroad as well as from within the country.

Among them is Gil Granot-Mayer. After a career in law, he led Yeda Research and Development Company, the technology transfer arm of the prestigious

Weizmann Institute of Science in Israel. In 2021, he joined the team at OIST as Executive Vice President for Technology Development and Innovation. Granot-Mayer shared some insights about what makes OIST a unique innovation driver and how it has been collaborating with various players to support research, startups, and the Okinawan economy.

"In December last year, the Nature Index looked at several universities in terms of research output normalized to size and OIST was ranked top," says Granot-Mayer, referring to an analysis measuring high-quality articles as a proportion of an institute's overall research output. "We are small number-wise. But on average, we are much more impactful in leading Japan and the world. This is a testament to our research quality. For a young university of 10 years in a remote location, this is an extraordinary achievement. In my opinion, this has been a tremendous return on investment for Japan."

Granot-Mayer points to several factors that are enabling OIST to outperform. The focus is international, with English as the main language, and the structure is flat and interdisciplinary. To encourage collaboration, there are no departments, and each research group has secure, long-term funding, which allows researchers to be bold and take risks, maximizing the odds of generating breakthroughs. In addition, OIST has dedicated to housing and other



OIST is an interdisciplinary graduate school that attracts leading researchers from around the world. Courses and research are conducted entirely in English. OIST has also been selected by the government as one of the research centers for quantum technology innovation. Photo shows the Quantum Materials Science Unit.



Gil Granot-Mayer, an executive vice president at OIST, led the commercial arm of Israel's Weizmann Institute of Science. He says OIST will help establish a fund to invest in high-growth startups that can sow the seeds of an innovation ecosystem.



OIST is located in Onna Village on the main island of Okinawa, one of the most popular resort destinations in Japan. The campus is designed to blend in with its surroundings, with stone walls that reflect the traditional architecture of Okinawan castles.

facilities and services to attract foreign students and staff. In early 2022, OIST had 255 Ph.D. students from 50 countries and territories.

One of the greatest public health threats in recent decades has been COVID-19, which has been a serious challenge on many levels for OIST, as it has for other academic institutions.

In this battle against the virus, one of most important assets is mRNA, which was co-discovered by one of OIST’s own founding scientists, Nobel Prize laureate Sydney Brenner. Noting that it took 60 years of continuous efforts in basic research for this discovery to finally mature into the form of a coronavirus vaccine, Granot-Mayer emphasized the importance of basic scientific research and compounded upon how it can benefit society. That is exactly what the Technology Development and Innovation Center, TDIC, is working toward.

OIST’s Innovation Square Startup Accelerator program is dedicated to fostering and commercializing new technology to support economic growth. The prefectural government sponsored its establishment in 2018 as the first global accelerator in Okinawa. Each year, OIST chooses two global startups to receive a residency program and 10 million yen in funding. In addition to scientific expertise, they can receive useful feedback from OIST’s community of venture capitalists. By catalyzing startups in Okinawa, OIST aims to strengthen the innovation ecosystem around the university and contribute to self-sustaining

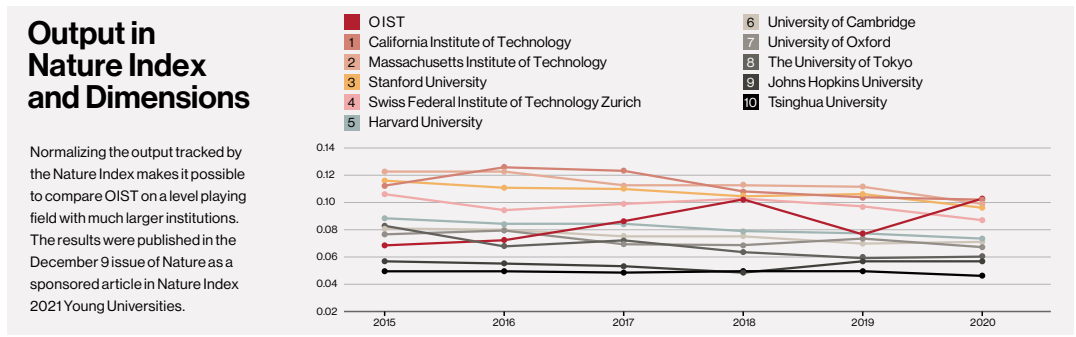
economic development in the region. Meanwhile, OIST is helping create a 40-50-million-dollar fund for early-stage support of startups from OIST, Okinawa, and around the world.

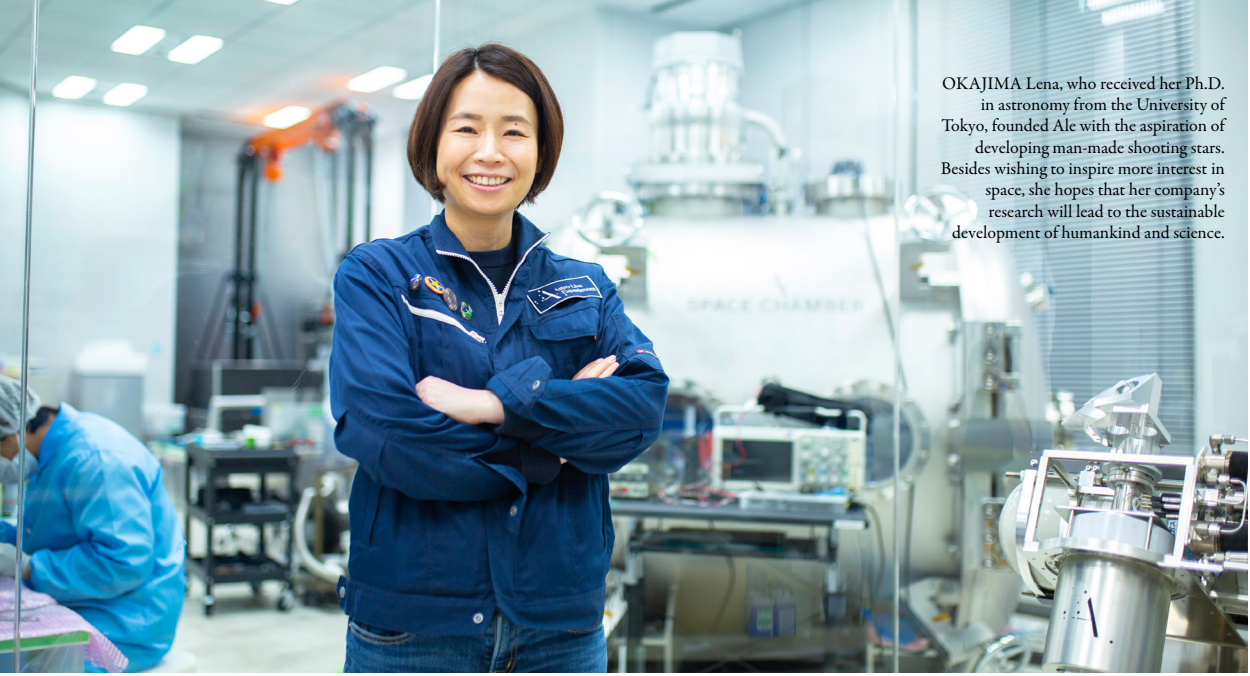
“As of May 2022, we expect five companies from the Accelerator Program to have established a presence in Okinawa,” notes Granot-Mayer. “While this is a small program, it is proof of concept of a good thing we can do to encourage startups and innovation to come here.”

Looking to the future, Granot-Mayer sees great potential in OIST’s research and innovation due to continued support from the central government and Okinawa.

“I see great value in diversification and openness in Japan,” says Granot-Mayer. “The more Japan can bring in talent from abroad, do everything in English and select top researchers and funding according to international standards, the better for Japan’s competitiveness. Putting more money into supporting basic research and students is the right direction for Japan.”

Chosen as one of the institutions in Japan that will develop quantum technology—one of the crucial areas for implementing the New Form of Capitalism proposed by the Kishida administration—OIST is an example of success in prioritizing high-level research. To reinforce Japan’s renowned science and technology infrastructure, the government has announced a fund of 10 trillion yen to create top-class universities. As a science powerhouse as well as a hub for innovation, OIST is acting as a launchpad for new ideas in Japan and around the world. ●





OKAJIMA Lena, who received her Ph.D. in astronomy from the University of Tokyo, founded Ale with the aspiration of developing man-made shooting stars. Besides wishing to inspire more interest in space, she hopes that her company's research will lead to the sustainable development of humankind and science.

THE DAY WHEN MAN-MADE SHOOTING STARS WILL SHINE IN THE SKY

As part of its growth strategy, the Kishida administration has pledged its support for startup companies. A leader in innovation, Ale Co., Ltd. is pioneering the original idea of releasing man-made shooting stars into the night sky. This new startup won a prize in the 21st Japan Venture Awards and now seeks to develop its own unique technologies for sustainable progress in space exploration and scientific development.

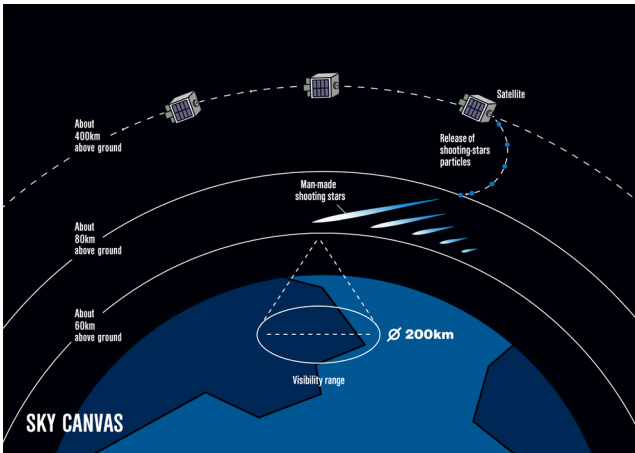
It all began in November 2001 with the Leonid meteor shower. The shower of shooting stars fizzling through the night sky consisted of tiny dust particles from outer space that burn up as they enter the Earth's atmosphere. Given their relatively simple composition, one can create their very own shooting stars—inspiring

the idea of making falling stars visible on demand from anywhere in the world. While majoring in astronomy at the University of Tokyo, OKAJIMA Lena was able to envisage such a possibility.

To make her dream a reality, Okajima founded Ale Co., Ltd. in 2011. For a man-made shooting



Left: Ale's man-made shooting stars, designed to be observable for a longer duration than natural shooting stars, will be visible within a 200-km diameter in the night sky. The company is also looking to branch into new business areas such as tourism. ALE CO., LTD.
Right: The shooting star particles—just 1 cm in diameter—will completely burn up in the Earth's atmosphere and are designed not to collide with other objects orbiting the Earth. ALE CO., LTD.



In the Sky Canvas mission, which will release shooting stars in the night sky, particles of about 1 cm in diameter are to be released by a device installed on a satellite. The meteor particles will look like shooting stars as they burn up at an altitude of about 60-80 km, and from the Earth's surface will be observable at a maximum distance of 200 km. ALECO,LTD.

stars on such a grand scale, our goal is to inspire more interest in science and curiosity about the universe, and at the same time, we hope to contribute to a sustainable Earth and space with the technologies we develop.”

One goal that the company has set as its mission is solving the problem of space debris. In collaboration with the Japan Aerospace Exploration Agency (JAXA), Ale has developed a device to use the Earth's atmospheric drag and the Lorentz force to change the orbit of old satellites and the upper stages of rockets, bringing them down to a level where they can safely burn in the atmosphere, thus preventing them from becoming debris.

The company is also developing a technology to measure water vapor concentrations from around sea level up to an altitude of about 50 km using remote sensors on satellites. Atmospheric observations at sea are relatively difficult, and the data available are scarce compared to measurements from the ground. Using satellites to obtain the wealth of oceanic atmospheric data that is currently lacking will not only improve weather forecasting but will also help unravel the mechanisms of climate change and extreme weather.

To develop the necessary science and bring innovations to space is the strong desire that drives Okajima. “We plan to extend into a variety of businesses. For example, we can use the technology as a tourism resource by releasing shooting stars at events worldwide,” she says. “Over the last decade, the environment surrounding space exploration has changed dramatically, making it easier to obtain technical cooperation or raise funds.”

The Kishida administration is promoting Japan as a science and technology nation and has proposed comprehensive support for startups. Just as Okajima pioneered a space business with her novel idea, new innovators will contribute to creating future industries. ●

star to be created, a small satellite will be launched that releases particles roughly 1 cm in diameter. These particles will then burn up as they enter the atmosphere to look just like shooting stars when seen from the ground. The shooting stars developed by Ale will emit light observable even from brightly lit cities, with the spectacle lasting for a few seconds longer than natural shooting stars. “Fireworks can be seen from about 10 km away, but man-made shooting stars will be observable with the naked eye over an area 200 km in diameter. I hope that people will share those precious extra seconds to enjoy the fun and excitement of looking up at the night sky,” explains Okajima.

Technological development on small satellites and a meteor-release device proceeded smoothly at first thanks to the support of a university and other organizations, enabling the launch of two satellites in 2019. Though Ale's first man-made shooting stars had been scheduled for release in 2020, this unfortunately had to be postponed due to a malfunction with one of the satellites. Undeterred, however, the company is aiming to release the world's first man-made shooting stars in 2023.

Ale's activities are not limited to painting the sky through the science of shooting stars under the Sky Canvas project. Okajima, who majored in astronomy, explores how science can lead to business. “I strongly believe that fundamental science is crucial for the sustainable development of humankind. Through space entertainment with man-made shooting

MAKING A BIG LEAP IN MAGNET INNOVATION

The neodymium magnet has enhanced the performance of a wide range of products, from electronic devices to electric vehicles and wind turbines. The magnet's inventor and developer, who was recently awarded the world-renowned Queen Elizabeth Prize for Engineering, speaks about the driving forces that led to this breakthrough and the potential for upcoming technological innovations.

The shift to electric vehicles and fuel cell vehicles is accelerating around the world, as many countries strive to achieve carbon neutrality. Japan is also promoting the widespread use of these vehicles and has set the goal of having electrified vehicles account for 100% of new passenger car sales by 2035.

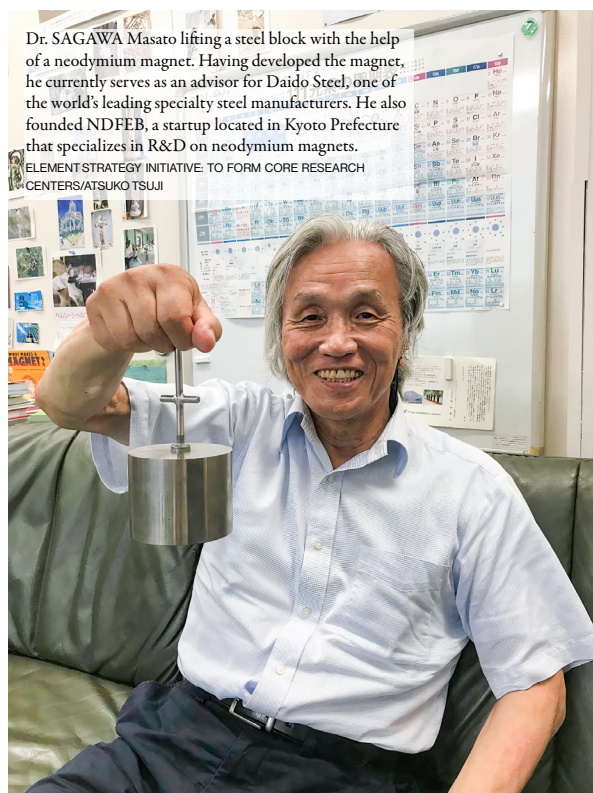
Among the various technological innovations that have enabled the mass production of electric vehicles, the most crucial has been the neodymium magnet (also known as the NdFeB magnet). Featuring high heat resistance and powerful magnetic strength—strong enough that one gram of it can lift 1kg of steel—the magnet has made possible the creation of the small and powerful motors that are indispensable for such vehicles. It has also contributed to enhanced performance and reduced costs in a broad range of items, from HDDs used for personal computers to air conditioners and wind turbines.

“I didn’t think it would be used so widely,” says SAGAWA Masato, the Japanese scientist who developed the magnet

in 1982. In February 2022, he was awarded the Queen Elizabeth Prize for Engineering—one of engineering’s most prestigious awards, honoring bold, groundbreaking innovations that are of global benefit to humanity—for developing the world’s most powerful permanent magnet, which has been transformational for its contribution towards enabling cleaner, energy-saving technologies. “To have something I devised myself be of such benefit to society—I couldn’t be happier,” he adds.

Back in the day when the strongest magnets were deemed to be those made mainly from the two basic elements of samarium and cobalt, Sagawa turned his attention to iron. Pursuing a hunch that excellent magnets could be made from iron—less expensive and more plentiful than cobalt—Sagawa began conducting his own research in that direction while working on developments such as samarium-cobalt magnets at a major Japanese

electronics manufacturer. He didn’t receive the go-ahead from his company to develop an iron-based magnet, however, since the element was considered unsuitable for making a super-strong magnet. But believing that such a magnet would surely contribute to the world, he continued to persist with his work, and in 1982, after joining Sumitomo Special Metals (now Hitachi Metals), he succeeded in developing the neodymium



Dr. SAGAWA Masato lifting a steel block with the help of a neodymium magnet. Having developed the magnet, he currently serves as an advisor for Daido Steel, one of the world's leading specialty steel manufacturers. He also founded NDFEB, a startup located in Kyoto Prefecture that specializes in R&D on neodymium magnets.



Neodymium magnets (center) are mainly composed of iron—an abundantly available and inexpensive substance—along with neodymium and boron. Their low cost has led to their rapid popularization and has greatly improved performance for a wide range of products: from air conditioners to personal computers, electric vehicles, and wind turbines. AFLO (top left photo); SHUTTERSTOCK (center, top right, and bottom left); EYEEM (bottom right)

magnet.

Spurred on by the advantages of its low cost and having twice the magnetic force of the samarium-cobalt magnet, applications of the neodymium magnet spread rapidly. Even now, nearly four decades later, there is no magnet that can surpass it.

Now aged 78, Sagawa can still be found at the frontline of development working to improve the neodymium magnet. He recently succeeded in substantially reducing the magnet's ratio of dysprosium—a heavy rare-earth element in particularly scarce supply—while enhancing its strength. This magnet also has the potential to improve energy efficiency through properties that help keep the temperature of the motor from rising. “Motors

consume almost half of the world's electricity. The widespread use of electric vehicles will only result in further consumption. Under such circumstances, even the slightest improvement in motor efficiency will contribute substantially to carbon neutrality,” he says.

Japan has developed technological innovations not only in magnets, but also in such materials as carbon fiber and high-tensile steel, which play crucial roles in creating products in a broad range of fields. According to data for 2017, Japanese companies accounted for at least 60% of the global market for up to 70 advanced materials used in high-tech fields. “Materials have been the backbone supporting civilizations from time immemorial. We can solve extremely large problems through

the innovation of materials. That's why I want young researchers to find projects that will benefit society and aggressively pursue them,” states Sagawa. With the aim of making the world more convenient and eco-friendly, Japan will continue along this path to seek new innovations. ●



A major feature of the neodymium magnet (left) is its strong magnetic force; it is about 10 times stronger than a ferrite magnet (right), the most widely used magnet in the world, including for daily necessities. NATIONAL INSTITUTE FOR MATERIALS SCIENCE

The space avatar in “Kibo”, the Japanese Experiment Module on the International Space Station. JAXA official ICHIKAWA Chiaki said, “This was the first test to access Kibo and send commands from outside a JAXA facility. The incredibly clear video feed impressed the participants.”



GO TOGETHER, GO FAR: A GRAND SPACE- AVATAR DREAM FULFILLED BY OPEN INNOVATION

Open innovation is a vital part of the Japanese government’s growth strategy. It aims to create innovative technologies and services by fostering collaboration between government, the private sector, and academia. One good example is the space avatar project that a startup, a research institute, and a local government have teamed up to produce.

In the more than six decades since humanity first ventured into space, only some 560 people have traveled to this frontier. But in 2020, about 400 people experienced outer space in a four-day span. How was that possible? Think “avatars.”

In 2020, avatarin, a startup spun out of the airline company ANA Holdings Inc., partnered with the

Japan Aerospace Exploration Agency (JAXA) and Oita Prefecture to install a remotely operated robot specialized for activities in space—a “space avatar”—in the Japanese Experiment Module “Kibo” on the International Space Station. That same year, they held an event that allowed members of the public to control the space avatar from Earth. About 400

The space avatar project won the top prize at the 4th Japan Open Innovation Prize in 2022, where the Japanese government recognizes excellent examples of open innovation. Pictured at the award ceremony from left: HAYASHI Takanori, representing Oita Prefecture; avatarin’s COO, KAJITANI Kevin, and CEO, FUKABORI Akira; ICHIKAWA Chiaki of JAXA.



Avatars are coming into more widespread use in cultural facilities. For example, they provide tours at aquariums and museums.

people, mentioned above, participated in this event.

avatarin defines mobility as being able to transmit one's consciousness to a remote location and move around on one's own initiative. The company has been developing its robotic avatar technology to pioneer a new mode of transportation accessible to all. By using an avatar, people can easily transport their thoughts into space, a place where very few people can travel due to physical constraints. This is a concept that avatarin has been developing since its establishment. The company's CEO, FUKABORI Akira, said, "The space avatar plan was too grandiose for us to achieve on our own, so we sought out partners. JAXA and Oita Prefecture were the first to jump at the opportunity." They were a perfect match for avatarin's vision: JAXA anticipates the application of avatar technology to space education, exploration, and development, while Oita Prefecture wants to use advanced technology to solve problems in its communities and promote its local industries.

To help develop the space avatar, many demonstrations using the terrestrial avatar "newme" were conducted. Oita Prefecture, which provided the test field, is located far from Japanese metropolises like Tokyo and Osaka and has many remote islands and mountainous regions. The prefecture sees avatars as a way to address local challenges like poor transportation. HAYASHI Takanori, an Oita Prefecture official, said, "We have conducted a number of demonstrations using avatars, including supervising elderly people, communicating with people who are working away from home in Oita, allowing a hospitalized high school student to participate remotely in afterschool activities, and implementing a remote sightseeing experience of Oita at an overseas tourism exhibition. Especially since the COVID-19 pandemic, the avatars have been used as substitutes for school trips by providing remote tours at museums, etc., and are also used as a means of remote shopping for local shopping districts that have suffered a loss in customer traffic."



Top: Avatars offered by avatarin. The monitor displays the user's face, and the user can tell the avatar where to go and look.
Left: Demand for online shopping has exploded during the pandemic. Oita Prefecture has used avatars at farmers' stands selling marine and agricultural products.

This success has led to the mass production of avatars in the prefecture, creating a new local industry with growing promise.

In a time when society and the technology around us are changing dramatically, conducting research and development has become difficult for a single player alone. Hence the increasing need for open innovation like that carried out by avatarin and others, where companies, laboratories, and local governments collaborate outside their own organizational frameworks. Fukabori pointed out that "even if you want to engage in open innovation, it's not easy getting organizations with different financial and human resources to work together." That is why the Kishida administration has encouraged investment in startups to cover their financial weaknesses, the strengthening of collaboration between government, the private sector, and academia, and reformation of universities to attract more talent and funds as a growth strategy that will help create a new form of capitalism—a core administration policy.

"If you want to go fast, go alone. If you want to go far, go together," said Prime Minister Kishida during his very first policy speech, expressing his ambitions going forward. If open innovation can create teams of talent like the one that put avatars in space, then any dream, no matter how grand, can become a reality. ●

THE IMPACT OF AI: ANYONE CAN BE A SKILLED FARMER

Artificial intelligence, or AI, has made rapid gains in recent years as it approaches the level of human intelligence. The Government of Japan has formulated a national strategy that is accelerating efforts to apply AI to real life. One example of the high-level AI social implementation pioneered by Japan is agricultural pest diagnosis using AI—part of a smart agriculture drive.



FarmChat is an agricultural ICT app offered by Farm Alliance Management. It uses the AI pest identification system developed by the NARO-led consortium. The user sends a photo of the produce damaged by a pest, which FarmChat uses to determine the disease and the harmful insect. An increasing number of farms are using the app. CREATED USING AN IMAGE TAKEN FROM THE AI PEST IMAGE DB (<https://www.naro.affrc.go.jp/org/miaes/damage>)

“AI will surpass human intelligence.” Such a comment is a sign of how remarkable AI’s recent progress has been. The Government of Japan considers AI a core part of its growth strategy in seeking to achieve a new form of capitalism as proposed by the Kishida administration. Since 2019, a national strategy has been in motion to conduct R&D and implement AI in society. Under the AI Strategy 2022 announced this April, Japan aims to create Society 5.0—the next logical step in the progression from a hunter-gatherer society through an agricultural society, industrial society, and the information society of today—which will achieve advanced convergence between cyberspace and physical space. In order to take that step, the AI strategy sets new goals to make AI a more entrenched part of society and

creates a concrete action plan to respond to emerging threats and challenges facing society, such as pandemics and major disasters.

With the support of that strategy and the Public/Private R&D Investment Strategic Expansion Program (PRISM), a national government initiative to create scientific and technological innovation, the implementation of AI has led to a notable evolution in agriculture. Japan’s temperate and wet climate is also unfortunately conducive to a wide variety of pests. Indeed, those plants and animals designated as harmful species by the government, and thus controlled through a pest forecasting project, total some 110 species of insects, pathogens, and so forth. Subduing these menaces requires their prompt identification,

followed by appropriate countermeasures. In recent years, however, Japan's aging farming population and the increase in the number of new farmers and farming organizations has led to greater difficulty in the smooth transmission of techniques for pest diagnosis and pest control. It has been noted that global warming and abnormal weather patterns may lead to an increase in the pest population, as well as changes in when and where they appear. That means conventional knowledge may be insufficient to cope with controlling these pests.

In response, a consortium led by the National Agriculture and Food Research Organization (NARO) has developed a sophisticated system using AI to identify images of agricultural pests. This will enable relatively inexperienced farmers to quickly and accurately identify pests. The system is expected to be part of a smart agriculture approach that uses fewer agricultural chemicals and makes farming more efficient.

Similar systems are under development around the world, but the NARO-led consortium says its system is superior in terms of the quality and quantity of data used to train the AI. Working with public research organizations in 24 Japanese prefectures, the consortium has gathered approximately 700,000 images of pests that experts have tagged with accurate labels. Furthermore, the consortium has collaborated with universities and system development firms with AI knowledge to recognize images more accurately by removing backgrounds and detecting objects with a convolutional neural network, a deep learning method modeled on the human visual cortex. The result is a system that can recognize major pests of four crops—tomatoes, cucumbers, strawberries, and

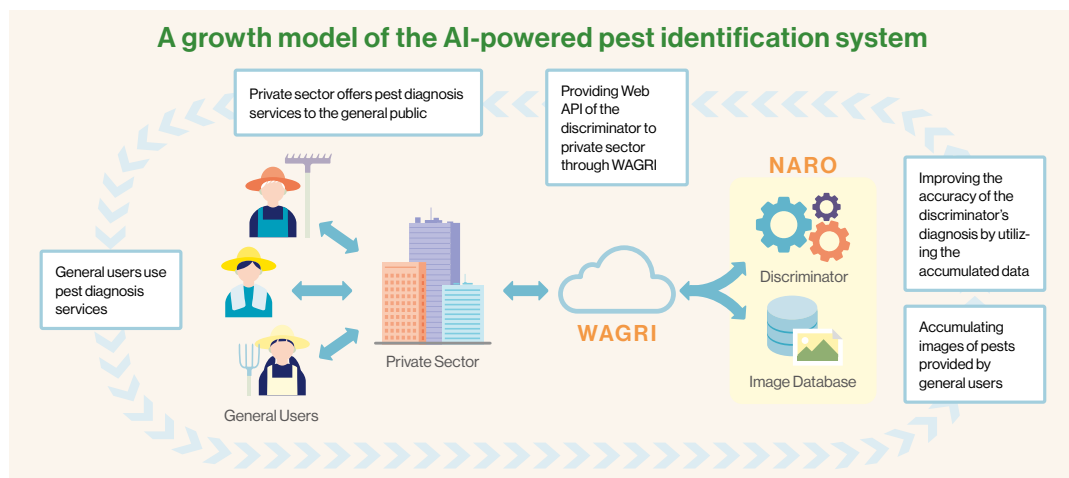
Examples of pests identifiable with a system developed by a NARO-led consortium. Photo shows crown rot of a strawberry. AI PEST IMAGE DB (<https://www.naro.affrc.go.jp/org/niaes/damage>)



eggplants—with more than 80% accuracy.

Challenges arose when putting the system into practice. YAMANAKA Takehiko from NARO said, “We’re a research institute, so developing commercial services is not within our expertise.” NARO decided to use a cloud service, the WAGRI agricultural data collaboration platform, to release this AI diagnosis system as a web Application Programming Interface (API) in 2021. It provides private enterprises with affordable access to the system so as to develop their own AI pest-diagnosis apps. As a result, the technology has quickly been accepted in practical agricultural fields. This year, eight more crops were added to the system. Next, the consortium plans to create a data aggregation scheme to train AI with data collected from general users to further bolster the system’s accuracy. The system will also gain a feature to provide information on both the ecology and control methods for identified pests. The consortium has received inquiries from private businesses about rolling out the system in other countries and may consider localizing it in the future.

People program AI and AI helps mankind. Through this cycle, humanity and AI will grow together, which will turn Japan into a scientific and technological powerhouse. The fruits of the growth reaped by AI will be enormous. ●



KIZUNA

Summer 2022

Published by



JAPAN GOV
THE GOVERNMENT OF JAPAN

Edited by

Public Relations Office, Cabinet Office
and
Office of Global Communications, Cabinet Secretariat
1-6-1 Nagatacho, Chiyoda-ku, Tokyo
100-8914, Japan

Available in electronic format.
<https://www.japan.go.jp/kizuna/>

eBooks **amazon**kindle

We would be delighted to have your feedback.
Please send us your comments.
https://www.kantei.go.jp/foreign/forms/comment_ssl.html

Links to the websites of ministries

Cabinet Office	https://www.cao.go.jp/index-e.html
Ministry of Agriculture, Forestry and Fisheries	https://www.maff.go.jp/e/
Ministry of Defense	https://www.mod.go.jp/en/
Ministry of Economy, Trade and Industry	https://www.meti.go.jp/english/
Ministry of Education, Culture, Sports, Science and Technology	https://www.mext.go.jp/en/
Ministry of the Environment	https://www.env.go.jp/en/
Ministry of Finance	https://www.mof.go.jp/english/
Ministry of Foreign Affairs	https://www.mofa.go.jp
Ministry of Health, Labour and Welfare	https://www.mhlw.go.jp/english/
Ministry of Internal Affairs and Communications	https://www.soumu.go.jp/english/
Ministry of Justice	https://www.moj.go.jp/EN/
Ministry of Land, Infrastructure, Transport and Tourism	https://www.mlit.go.jp/en/
Digital Agency	https://www.digital.go.jp/en/
Reconstruction Agency	https://www.reconstruction.go.jp/english/
Nuclear Regulation Authority	https://www.nsr.go.jp/english/

JapanGov (<https://www.japan.go.jp>) is your digital gateway to Japan. Visit the website and find out more.

JapanGov, the official portal of the Government of Japan, provides a wealth of information regarding various issues that Japan is tackling, and also directs you to the sites of relevant ministries and agencies. It introduces important policies that the government is addressing, such as economic growth, innovative technology, and diversity, among others, with many videos and infographics.

JapanGov News
Find the Latest News from the Government Ministries and Agencies, and Information Related to COVID-19

Featured Articles and Topics

- Technology**
Innovative technologies and ideas are changing the way people live, and contributing to the world.
- About Japan**
Learn about the basic information: the national flag and anthem, statistics, and more.
- #COVID19**
Novel Coronavirus (COVID-19)
See the latest information and advice on the Ministry of Health, Labour and Welfare website.

You'll also find the official web magazine "KIZUNA"
(<https://www.japan.go.jp/kizuna/>).

Follow us to get the latest updates!





Japan. Sharing tomorrow.

KIZUNA

<https://www.japan.go.jp/kizuna/>



JAPAN GOV
THE GOVERNMENT OF JAPAN