

MASTER TECHNIQUES 1

from
Japan to
the World

“Smart Mining+”: Japanese-Developed Technology Set to Transform the Future of Mining Worldwide – Implementing a New Approach to Mine Development That Integrates Digital Technology and Environmental Considerations in Kazakhstan –

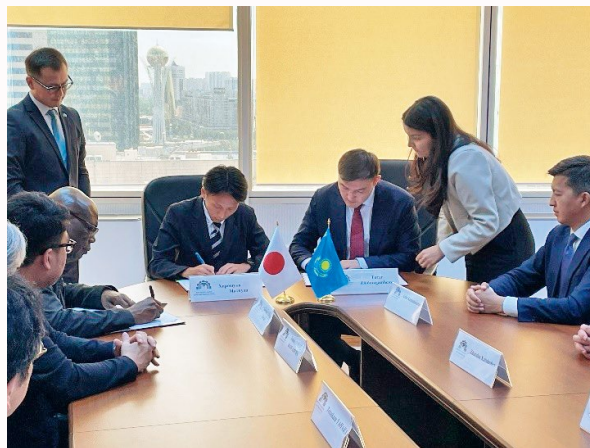


In recent years, as global demand for rare metals such as cobalt and lithium continues to expand, the stable supply of mineral resources that underpin our daily lives has gained increasing importance from the perspective of economic security for nations around the world. However, mine development inherently involves risks of environmental pollution. Groundwater that wells up inside the mine becomes contaminated with minerals and hazardous substances, polluting rivers and soil and adversely affecting agriculture and people's livelihoods in downstream areas. How can environmental pollution be prevented while maintaining the safety and profitability of operations? A Japanese-developed technology that aims to leverage digital innovation to address this challenge is attracting global attention.

At the heart of this effort is “Smart Mining+” (Smart Mining Plus), a concept advocated by Professor KAWAMURA Youhei of Hokkaido University. Building on the concept of “smart mining,” which combines Information and Communication Technology (ICT) with conventional mining engineering to ensure productivity and safety, “Smart Mining+” advances this by incorporating the perspective of “responsible mining,” an approach emphasizing harmony with the environment.

In conventional mines, planning and safety were typically analyzed on paper drawings as excavation proceeded underground. Under the “Smart Mining+” approach, however, the entire mine, hidden underground and invisible to the surface, is digitized and visualized in digital space. By integrating real-time sensor data from within the mine, it becomes possible to reproduce conditions underground in real time from the surface. Monitoring temperature, humidity, and other conditions inside the mine can also be applied to monitoring workers' environments for safety. For environmental protection, AI is expected to significantly contribute to preventing environmental pollution and accidents by simulating risks such as groundwater ingress and structural collapse.

This new initiative has been adopted under the Science and Technology Research Partnership for Sustainable Development (SATREPS)*1 program, implemented jointly by the Japan Science and Technology Agency (JST) and the Japan International Cooperation Agency (JICA). During the five-year research period, the technology will be implemented at a gold mine in Kazakhstan, a Central Asian country that is among the world's leading mineral-supplying nations. With Hokkaido University and the local Nazarbayev



Memorandum of Understanding signing ceremony among JICA, the Government of Kazakhstan, Hokkaido University, and Nazarbayev University (Photo: Hokkaido University)

University at the core, research institutions and private companies from both countries have been collaborating to establish network infrastructure and conduct geological surveys for approximately six months. Digitization work for the mine commenced in April 2025. In Kazakhstan, discussions toward establishing a certification system that would certify resources mined using this technology began as part of efforts to promote environmentally sound mine development.

At the heart of “Smart Mining+” lies the philosophy of eliminating sources of pollution rather than responding post-contamination. Professor Kawamura observes, “Much like the concept of ‘mibyo’ (preventing disease before it manifests) in Eastern medicine, the approach of treating the root cause rather than responding after the fact may be something we as Easterners are particularly well-suited to.” Japan has a history of more than 100 years since the Meiji era of addressing mining-related environmental pollution through neutralization treatment. Professor Kawamura highlights Japan's unique role: “Japan's neutralization treatment technology is at a world-leading level. By providing this technology and expertise to mines currently in operation around the world and neutralizing contaminated water before it flows out of the mine, we can prevent environmental destruction and the occurrence of pollution.”

Japan is one of the world's leading consumers of mineral resources. Professor Kawamura speaks with conviction: “Rather than simply seeking resources, Japan can become a trusted partner by providing technology that reduces the environmental burden on partner countries and enables sustainable operations. The spread of technology based on ‘Smart Mining+’ could make a major contribution to Japan's ‘resource diplomacy’ over the medium and long term.” Regarding prospects, he adds with enthusiasm, “After the SATREPS research period ends, I want to commercialize this technology and deploy it around the world.” “Smart Mining+,” a fusion of digital technology and environmental consideration, leverages Japan's wisdom and experience to hold tremendous potential for transforming global resource development.



Survey inside the Sekisovskoye gold mine (Photo: Hokkaido University)

*1 See the glossary on page 43.

MASTER TECHNIQUES 2

from
Japan to
the World

Saving the Lives of Mothers and Newborns through Smartphone-Based Maternal and Child Health Checkups – Digitalization of Antenatal Care in the Democratic Republic of the Congo –



The Democratic Republic of the Congo (DRC), located in central Africa, is blessed with abundant mineral resources; however, the development of healthcare infrastructure has been delayed due to the impact of armed conflicts that have continued since the late 1990s, leaving many citizens unable to access adequate medical care. Less than approximately 6% of domestic medical facilities meet the healthcare standards stipulated by the government. In the field of maternal and child health, the maternal mortality rate is approximately 100 times that of Japan. The neonatal mortality rate is approximately 50 times that of Japan, with the situation being particularly severe in rural areas with poor access to medical facilities.

Against this backdrop, SOIK Corporation (pronounced “Sowak”), a company based in Okinawa, is tackling healthcare challenges in Africa through business, under the vision of “delivering high-quality healthcare to all mothers and children in Africa.” The company’s Representative Director and CEO, FURUTA Kuniyuki, previously worked as a JICA staff member stationed in the DRC, where he developed a strong conviction that the local healthcare situation needed to be improved through his involvement in international cooperation projects in the country. Mr. Furuta explains, “To drive innovation with new technology, I believed that the startup approach, which allows for repeated trial and error with minimum fear of failure, was the right fit.” He subsequently gained experience working at a startup developing portable ultrasound devices, before founding SOIK in 2019. The company currently works to improve maternal and child health through maternal health checkups using “SPAQ,” a solution developed with SOIK taking the lead.

SPAQ consists of medical devices (hardware) such as a portable ultrasound scanner and a blood pressure monitor, along with a smartphone application (software) with electronic medical record functionality. Even in remote clinics lacking adequate facilities and equipment, checkups can be conducted using the equipment that fits “in a single backpack” and a smartphone. Because it can be operated without advanced medical knowledge, both healthcare professionals and volunteer staff providing support in local communities can use it.

In conducting training sessions using SPAQ, the company placed particular emphasis on making it easy to understand. In the African region, where diverse ethnicities and languages intermingle and educational levels vary widely, the goal was to ensure that as many users as possible could reliably operate the system. Reflecting on the training approach, Mr. Furuta recalls: “We were conscious of checking participants’ level of understanding at each stage, proceeding carefully step by step, minimizing the difference in the ‘steps of understanding’ as small as possible.” The initiative, which began in the DRC, has since expanded to a total of four countries in Africa. SPAQ has been introduced to the health authorities of each country, with over 25,000 digital maternal health checkups already conducted, and more than 100 lives have already been saved.

Building on the track record accumulated in the DRC, in 2023 SOIK partnered with the United Nations Population Fund (UNFPA), which received support from the Government of Japan, to carry out a pilot introduction and demonstration project for SPAQ at internally displaced persons (IDP) sites in Goma, a major city in the eastern part of the country. Training was conducted for 12



Maternal health checkup being conducted using a portable ultrasound device at the Rusayo IDP site in the DRC (Photo: UNFPA DRC)



Mr. Furuta conducting training for local healthcare workers (Photo: SOIK Corporation)

healthcare workers, who were then dispatched to four IDP sites. The results demonstrated high demand on the ground, with the number of consultations at the IDP sites reaching approximately three times the initial target. The company continues to collaborate with UNFPA to work toward delivering high-quality healthcare in IDP sites.

With an eye towards more widespread adoption of SPAQ, Mr. Furuta emphasizes the need to work more closely with government authorities going forward, including through the integration of SPAQ into local health insurance systems. He also stresses: “The tests and devices we provide are merely one means to an end. Our goal is to reduce maternal and child mortality across the African continent.” He adds, “To that end, I want to build a self-sustaining business model by establishing outcome indicators that can be objectively evaluated, such as reductions in mortality rates.” He further expresses his aspiration to extend support to people in conflict zones around the world outside of Africa who lack access to adequate healthcare services. Currently, SOIK is working, with the support of the Government of Japan, to develop a “smartphone-based AI ultrasound” that can automatically determine gestational age and assess the risk of ectopic pregnancy and placenta previa, even in environments without network coverage, for expectant mothers who cannot access medical facilities.

Going forward, it is expected that by drawing on the technologies and expertise of Japan’s private sector and deepening public-private collaboration, these efforts will develop into a sustainable initiative that integrates technology transfer, human resources development, and institution building. A future is taking shape in which the healthcare system of the DRC is improved through this kind of “master technique,” ultimately contributing to regional stability and growth.

MASTER TECHNIQUES 3

from
Japan to
the World

Public
nomination

Preventive Malaria Control Using Drones and AI – Japan's Cutting-Edge Technology Transforming Infectious Disease Control on the Ground in Ghana –



Approximately 90% of malaria cases and deaths are concentrated on the African continent. In Ghana, in West Africa, an estimated 5 million or more people contract malaria while over 10,000 die from the disease each year, making it a serious public health situation. The Government of Ghana implements Larval Source Management (LSM), a countermeasure that eliminates the larvae (mosquito wrigglers) of malaria-carrying mosquitoes before they reach adulthood, by spraying a dedicated larvicide in the standing water where mosquito larvae breed. However, there are limits to manually mapping high-risk breeding sites and applying larvicide by hand, and the overuse of larvicide poses cost concerns, creating demand for improvements in efficiency and cost-effectiveness.

SORA Technology Co., Ltd., a Japanese startup company, is tackling this challenge by combining advanced digital technology with LSM. The company developed a proprietary sensing technology called "SORA Malaria Control," which integrates drones and artificial intelligence (AI) to efficiently monitor and analyze mosquito larval breeding sites across large areas. Mr. UMEDA Masaki, Vice Chief Executive Officer of the company, explains the results with confidence: "Using terrain data acquired by drones, we analyzed the data with one AI that identifies characteristics of standing water such as location and size, and another AI that estimates which bodies of water pose a high risk of mosquito larval breeding. We mapped the water bodies requiring larvicide application and shared that information with field spray operators via a mobile app, enabling accurate and efficient spraying that allows us to implement LSM at minimum cost."

Since 2023, the company has been utilizing JICA's SDGs Business Supporting Survey (JICA Biz) to conduct malaria control surveys in Ghana using "SORA Malaria Control." Mr. Umeda notes that "localization" is the key word in operating the system. In addition to adjusting the AI's specifications to align with Ghana's internet speeds and regulations, the company partnered with the University of Ghana to introduce a framework in which university students conduct field surveys as interns to enable the collection of local data that improves the accuracy of AI analysis. Mr. Umeda reflects, "For local youth, malaria is a familiar and immediate concern, and their participation with a genuine sense of ownership helped drive



Field survey conducted using a drone in Sierra Leone (Photo: SORA Technology Co., Ltd.)

the 'localization' forward. Students also explained the drone in local languages to residents who had never seen one before, which contributed to building understanding and trust within the local communities." Some participants went on to work as employees of SORA Technology after their internships, and Mr. Umeda looks to the next generation with high expectations: "I hope the younger generation operating LSM will also apply this technology locally, so that Ghana's malaria control efforts can advance even a little faster."

Measurements conducted at the Noguchi Memorial Institute for Medical Research (NMIMR), built in Ghana through Japanese ODA, and the University of Ghana have demonstrated that through the company's initiative, more than 3.6 times as many standing water sites were detected compared with conventional survey methods, and both larvicide usage and human resource costs were reduced by half. SORA Technology has held results-reporting sessions not only with the Ghanaian government, but also with local private companies engaged in CSR activities, and is working to expand the scope of larval control using its technology. Furthermore, building on its success in Ghana, the company has begun exploring the possibility of applying "SORA Malaria Control," not only in neighboring African countries, but also to other mosquito-borne infectious diseases such as dengue fever, as well as to pest control in the agricultural sector.

As the risk of infectious diseases spreading across borders increases due to globalization and climate change, this initiative benefits not only Ghana but the entire international community, including Japan. On this point, Mr. Umeda expresses his ambition: "Infectious diseases are now a pressing and familiar challenge for Japan as well, and we have plans to reverse-import technology developed in developing countries back to developed countries in the future. I want us to take the lead in promoting the expansion of Japanese companies into global markets and the creation of innovation domestically." The technology of this company that flies through the skies (SORA) to support Ghana's fight against infectious disease is expected to contribute not only to Sub-Saharan African countries, but also broadly to the advancement of global health as a new public health solution leveraging the cutting-edge knowledge and expertise of Japanese startup companies.



Spraying larvicide on standing water, which has a high risk of mosquito larval breeding (Photo: SORA Technology Co., Ltd.)

MASTER TECHNIQUES 4

from
Japan to
the World

ODA Using Japan's Space Technology Opens Up Paraguay's Future – Strengthening Capacity in Disaster Risk Reduction and Agriculture and Livestock through the Utilization of Satellite Data –



Paraguay, a landlocked country in Latin America, has agriculture and livestock as its principal industries, but forest fires caused by slash-and-burn farming and flood damage due to the effects of climate change have been growing increasingly serious.

Against this backdrop, responding to a cooperation request from the Government of Paraguay, JICA implemented the “Project for Management of Space Programs Applied to Socioeconomic Development,” the first technical cooperation project targeting a space agency in the Latin American and the Caribbean region, launched in 2023. The purpose of the project is to strengthen the capacity of the Paraguayan Space Agency (AEP)*1 and to contribute to socioeconomic development, including the strengthening of disaster risk reduction capacity and improvement of agricultural productivity through the utilization of satellite data. The initiative was led by Japan Space Systems (J-spacesystems), a general incorporated foundation with expertise in space technology, in collaboration with Paraguayan counterparts, as well as with technical support from PASCO CORPORATION and the Japan Space Forum. Dr. NAKAMURA Shinsaku of J-spacesystems explains: “At the time, AEP had a certain level of analytical capacity for satellite data, but the challenge was that even when satellite data was obtained after a disaster, such as a flood, the organization was in a lacking position to practically utilize the analysis results. Practical utilization required not only satellite data but also ground-truth information obtainable at observation sites, making it necessary to carefully train staff in field survey methods.”

Recognizing that a further challenge impeding the practical application of satellite data analysis results was a low level of coordination among relevant ministries and agencies, the project also established working groups between AEP and related ministries and agencies, covering the disaster risk reduction and agriculture and livestock sectors, which are priority areas for Paraguay. These groups worked to identify issues in each sector and develop applications and user manuals for satellite data utilization based on those issues.

As a pilot initiative in the disaster risk reduction sector, flood damage simulations utilizing satellite data were conducted in areas that frequently suffer inundation from river flooding, and disaster countermeasures such as disaster risk analysis and hazard mapping were carried out. Paraguay's National Emergency Secretariat requested that these measures be extended to other regions as well, and discussions are currently underway in the working group in parallel with the formulation of evacuation plans.

In the agriculture and livestock sector as well, while there is



Reviewing satellite data analyzed prior to the field survey practicum (Photo: J-spacesystems)

demand for improving the production efficiency of soybeans, a key export crop for Paraguay, and for countermeasures against disaster risks such as droughts and floods, there is also a need to diversify agricultural products to avoid excessive dependence on soybeans, and technical support for smallholder farmers, who account for approximately 90% of all farmers, had been a persistent challenge. In response, training sessions on the use of satellite and meteorological data were conducted, and by remotely monitoring the growth stages of soybean crops, a basis was established for determining optimal fertilization and irrigation timing, and for improving the accuracy of yield forecasts and cultivated land area assessments, paving the way forward for sustainable agricultural development. From the perspective of agricultural diversification, application to other crops, such as tomato cultivation, is also progressing and plans are under way to provide smallholder farmers with cultivation guidance based on satellite data analysis to help improve yields and quality.

The project also devoted significant effort to the development of Paraguayan small satellites and the cultivation of human resources in space-related fields. Exchanges between Japanese companies and public and private sector stakeholders in Paraguay have fostered even deeper collaboration toward the development of the space industry in both countries. Dr. Nakamura looks forward with high hopes to the contributions of young engineers: “It is important to increase the number of professionals who can apply satellite data across multiple fields by drawing on the technologies and knowledge gained in Japan. This will enrich the lives of citizens and lead to solutions for a variety of challenges.” He adds with conviction: “I hope Paraguay will become a hub for small satellite development and operation in Latin America and the Caribbean.”

Building on the outcomes of this project, in May 2024, during then Prime Minister Kishida's visit to Paraguay, the launch of the “Japan-Paraguay Space Cooperation Program” was announced, with the aim of advancing space sector cooperation by mobilizing both nations' industry, academia, and government through a combination of Japan's various forms of cooperation. To promote this program, a memorandum of understanding on cooperation in space development was signed by JICA, JAXA, and AEP. Going forward, Japan is expected to continue “co-creation” to address challenges using its space technologies through collaboration among industry, academia, and government, while expanding international networks with other countries.



Comparing crop growth conditions with satellite data analysis results during a field survey practicum (Photo: J-spacesystems)

*1 Abbreviation of Agencia Espacial del Paraguay.

MASTER TECHNIQUES 5

from
Japan to
the World

A Forest in the Gobi Desert

– A New Sustainable Greening Method Originating from
Mongolia and Environmental Education Initiatives for Children –



Desertification is advancing in Mongolia due to the effects of climate change and overgrazing. The country's government has been conducting tree-planting activities with the cooperation of other nations; however, in the extremely arid southern regions where annual precipitation is as low as approximately 100 mm, most planted trees die without irrigation (watering), and irrigation management has long been unable to keep pace.

In order to break through this situation, in 2009, the governor of Dornogovi province, located in the eastern Gobi Desert, drew on his experience of studying in Japan and reached out to Japanese organizations engaged in greening activities. Among them, the NPO Foreign Technological Interrelation Association In Niigata (hereinafter, the Association), a specified non-profit organization that has been sharing outstanding technological expertise both domestically and internationally for more than 35 years, responded to the governor's request and established the industry-academia-government joint "Niigata Prefectural Mongolia Greening Promotion Technical Cooperation Executive Committee." Although the Association had no prior experience in greening work in desert regions like Mongolia, it conducted baseline surveys on local flora and soils during the three years following the start of activities. Based on these results, the Association focused on wild trees such as the Siberian elm (*Ulmus pumila*) that grow naturally even in the harsh desert environment, and devised a new planting method called the "Deep-Hole Irrigation-Free Planting Method." Utilizing the JICA Partnership Program (JPP), preliminary trials were conducted from 2013, followed by verification trials of the method beginning in 2021.



Trees surviving at a 100% rate for three years after planting with no irrigation (Photo: NPO Foreign Technological Interrelation Association In Niigata)

The "Deep-Hole Irrigation-Free Planting Method" is a technique in which a deep hole is dug and the soil is pulverized, after which more than half of the excavated soil is backfilled, and a generous amount of water is applied before planting. This induces the roots of subsequently planted seedlings to grow deeper in search of this subsurface moisture. Its defining feature is that a large amount of water is poured into the deep layer before planting, and after planting, absolutely no surface irrigation is carried out. In practice, not a single seedling planted using this method died over a three-year period without any irrigation. Mr. MEGURO Shuji, a Director of the Association, reflects: "This result, which we have now confirmed, can be called an innovation in desert greening, one



Children's greening training at the verification site (Photo: NPO Foreign Technological Interrelation Association In Niigata)

that fundamentally overturns the planting methods that have been used in the Gobi Desert up to this point. It is a first for Mongolia and a rare achievement even globally."

Compiling the technical achievements of this project, the Association prepared a draft "Greening Manual" for desert regions, and through distribution to provincial staff in Dornogovi province, practical training, and workshops for local citizens, it is working in cooperation with local government to promote and establish the new greening technology. These initiatives have also attracted attention from greening stakeholders outside the province, with requests for information arriving from various parts of Mongolia and an increasing number of visitors to the verification site.

Because achieving greening in desert regions requires a long timeframe measured in centuries, the Association also devotes significant effort to environmental education for children. Targeting Mongolian children from a culture with deep nomadic roots where the habit of tree-planting has not taken hold, the Association has implemented lessons on "creating a school forest" as part of environmental education, with the aim of sparking their interest in the desert ecosystem and encouraging them to participate in greening activities with a sense of ownership. Specifically, in addition to visits to the "Deep-Hole Irrigation-Free Planting" verification site, children designed their vision of a forest and carried out deep-hole planting at their schools. Some children have shared that "I taught my family what I learned, and we started planting fruit trees at home," and by creating a "School Forest" with their own hands, an interest in greening is taking root. Director Meguro shares: "Local teachers have told me that the eyes of students who are involved with plants are shining. I would be delighted if the children take the purpose and significance of greening to heart and go on to contribute to spreading it in the future." The Association is currently working to expand this same initiative to all schools in the province.

Furthermore, an NGO called "Green Mother Land," composed of local staff who worked on this project, was established in 2024, and continues to carry out monitoring and awareness-raising activities together with the Association in order to spread the "Deep-Hole Irrigation-Free Planting Method."

Mongolia has set an ambitious target of planting one billion trees across the country by 2030. Japan will continue to work in collaboration across industry, academia, and government to provide support that helps reduce tree mortality as much as possible.