

South Korea's National Agricultural Research System (NARS) supported its transition towards a more sustainable and resilient agrifood system at home and abroad

The success story of South Korea's National Agricultural Research System (NARS)

South Korea is sharing its unique experience of a rapid transition from “developing” to “developed” country, with the strong role of the National Agricultural Research System (NARS) in its agrifood development. The fruits of South Korea's rapid advancement in the agrifood sector, specifically due to partnerships, investments and political support for its NARS, are now paving the way for innovative solutions that address the challenges of climate change, food security and sustainability in other developing countries. This story showcases the crucial role that collaboration and knowledge sharing can play in driving progress and creating impactful change. Through effective partnerships and a commitment to driving innovation, South Korea's NARS model has supported the country's successful transition from development aid recipient to a donor and contributed to a more sustainable and resilient future in the country and beyond.

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The history of South Korea's NARS

The Republic of Korea (South Korea)'s National Agricultural Research System (NARS) has undergone significant changes over the years. The country's agricultural sector was initially characterized as subsistence-based and lacked modern farming technologies. And after the Korean War the country faced many hardships and heavily depended on foreign aid for economic assistance.

After its independence and the Korean war the country faced rapid population growth, destroyed production infrastructure, natural disasters (such as drought, flooding, and typhoon), low Gross Domestic Product (GDP) per capita (USD 80 in 1960 – USD 254 in 1970), low rice self-sufficiency – 80.5 percent in 1970, food import equivalent to USD 206 million (19.3 percent of total export amount) in 1971, global food-shortage period (1950s-1960s) due to the World War II and poor harvest, which affected both Europe and Asia, as well as low access to agricultural technology (Jeong, 2023).

With the vision to achieve food sufficiency, the Rural Development Administration (RDA) was established in 1962.



*"We ate three times a day between September -February and two times a day between February-August," Il Jeong
JEONG (2023)*

The government has been actively promoting agricultural research and development (R&D) as a key driver of economic growth and job creation.

Key milestones of South Korea's NARS success

At the national level, the Korean NARS has achieved several important milestones, in the face of many challenges. IR8 rice was released by 1966, and distributed as the first modern semi-dwarf rice variety. Japonica rice (Temperate) variety was released in 1960s, but showed lodging, limited yield potential, low photosynthesis and insufficient yield. Tall Japonica rice was incapable of applying high Nitrogen and dense planting, while ensuring high-yields, so South Korea needed to search for new solutions and strategies that would guarantee high yielding rice varieties suitable for Korean production (Jeong, 2023).

The country adopted the following important strategies to address the problem (Jeong, 2023):

- Started international cooperation in research with the International Rice Research Institute (IRRI);
- Introduced IRRI-bred materials with short culm and erect-leaves type;
- Developed cultivation technology for the low-productive paddy in Korea;
- Trained rice researchers and extension officers in Korea and at IRRI;
- Invited IRRI experts to Korea;

- Started shuttle breeding and utilization of IRRI facilities;
- Established new greenhouse and phytotron facilities for rice breeding in Korea.

This resulted in the development of Tong-il rice that eventually became the core of the unprecedented Korean Green Revolution in mid-1970s leading to Korea's rice self-sufficiency within six years.

The development of "Tongil" rice variety in 1971 was recognized as Korea's first top R&D achievement for the last 50 years.

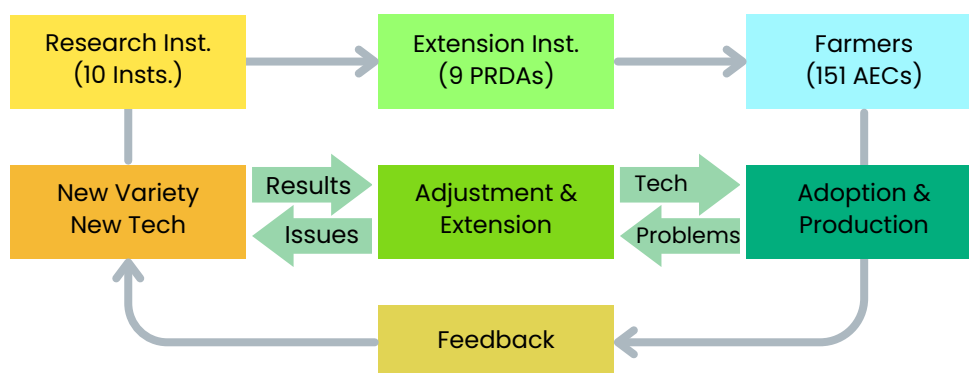
Its advantages included high yielding potential, improved plant architecture, high photosynthetic ability, and resistance to major diseases and insects. Furthermore, the seed production system evolved with RDA playing a crucial role. The production of Tong-il variety seeds happened 2-3 years earlier than normal procedure, which significantly shortened seed generation. In addition, cultivation techniques improved from "Flooded nursery" for Japonica rice Before 1960s, to "Vinyl protected nursery" for Tong-il varieties after 1970s. Optimum cultural practices were achieved through reducing seeding and transplanting times, improved transplanting methods and planting density, N application and efficient pest control (Jeong, 2023).

The key to South Korea's self-sufficiency of rice in the short term:

- Developed Tongil- type rice varieties, high yielding potential
- Strengthened linkages between agricultural research and extension
- Improved agricultural policies and strategies

This success continued after the White Revolution in the 1980s, when the country began to diversify its agricultural production through new crop technologies and increased use of plastic films in greenhouses, which stabilized the year-round supply of vegetables and other horticultural crops in the country.

An important part of this success is South Korea's effective agricultural research and extension linkage system that was built during the 1980s, and in 1985 recognized by FAO as the most efficient system (Kim, 2012). This success was due to RDA's integration of both research and extension under its mandate, and its establishment of an effective feedback mechanism between researchers, extensionists and farmers (ref. Fig. 1) (Jeong, 2023).



Research Inst.: **10** National Institutes on Crop, Horticulture, Animal, Basic Researches, RDA
 Extension Inst.: **9** Provincial RDAs, **151** City/County Agriculture Extension Centers, RDA

Farmer training was at the centre of the RDA's well-developed research and extension system. It followed a systematic capacity development model based on the following (Jeong, 2023):

- **Technical training of farmers** in winter, and on-site training in summer that included extension service, demonstration, and evaluation meetings.
- **Media-based training** that included broadcasted training by rice experts on the radio and TV; news on latest technologies through central, local and agricultural newspapers; and publication of educational materials.
- **Strengthening farmer cooperatives** through demonstration farms for rice-cultivation.
- **Training for farmers' understanding** on new varieties and technologies that led to selection of new varieties by farmers and their rapid dissemination.

The importance of political leadership and support

The strategy of international partnerships (e.g. with IRRI), technology advancement and farmer training were not the only factors behind South Korea's NARS success. A "Food Production Situation Room" was established in the Presidential house in 1973 to discuss all agriculture-related issues, including the farming situation and weather. A policy decision was made to set production quotas and phase farming into seven stages to better support farmers in transplanting activities. The government also introduced incentives to award farms with good harvest. For example, USD 250 was given to farms producing rice yields over 6 t/ha. In addition, the government provided systematic administrative support to the NARS by establishing ten specialized research institutes at RDA, which overall managed research, extension and knowledge dissemination. Supported by the effective agricultural research and extension system, high-yielding farms grew from 3,765 in 1973 to 53,808 in 1976. The President – Park Chung-Hee – provided encouragement and strong support to farmers through favourable agricultural policies, such as an agrarian reform and grain policy (Jeong, 2023).

The advancement of South Korea's agricultural production and increasing demand for high quality agricultural products worldwide subsequently created new opportunities for farmers and agribusinesses to expand into international markets.

Sharing success through international cooperation

South Korea achieved a high level of agricultural mechanization and productivity within 40 years, through a combination of policy measures and investment in agricultural innovation that has been fundamental to ensuring the long-term competitiveness and sustainability of Korean agriculture. Now, South Korea is one of the most intensive investors in public agricultural R&D among OECD countries. (OECD, 2018). Given the country's remarkable rise from a recipient of development assistance to OECD member, South Korea represents a good development model for developing nations, and thus has cultivated partnerships with countries especially in Africa and other parts of Asia to support their sustainable agricultural development.

Through the International Technology Cooperation Center (ITCC), the RDA has expanded its global reach in starting in 2009 with the establishment of the Korea Project on International Agriculture (KOPIA) and forging international technology cooperation networks in three regions, namely, Asia, Africa, and Latin America.

In 2010, South Korea officially became a member of the Development Assistance Committee (DAC) of the Organization for Economic Cooperation and Development (OECD) and hailed as the only country that has emerged from being a recipient to a donor country.

Generally, South Korea's NARS has evolved significantly over the years, with the government playing a key role in promoting modernization, diversification and sustainability through its administration and policy support. The country's international partnerships in agricultural research have helped to promote knowledge sharing and collaboration, ultimately leading to improved agricultural productivity and food security in the country.

RDA's International Cooperation Initiatives

Recognizing the need for Korean agriculture to look beyond its territory, RDA envisioned to share its agricultural technology with the world, strengthen capacities in agri-food production beyond its country, and create opportunities to also strengthen research capacity of its own researchers through international training, exchange, research cooperation, and introduction of genetic resources.

To date, RDA has built networks and cooperation with 62 countries – both developed and developing ones – to help them address issues related to food security and climate change. With advanced and resource-rich countries, it fosters partnerships and facilitates knowledge sharing to be able to leverage cutting-edge technologies and develop field-based technologies with farm-level applications to further strengthen the agricultural industry. At the same time, it supports developing countries with locally-adaptable technologies to help farmers improve productivity and sustainability.

Scaling up South Korea's success in Asia

The Asian Food and Agriculture Cooperation Initiative (AFACI) led by South Korea is an inter-governmental and multi-lateral cooperation body that has been building international partnerships with its fifteen member countries, including Bangladesh, Bhutan, Cambodia, Lao PDR, Indonesia, Kyrgyzstan, Mongolia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Uzbekistan

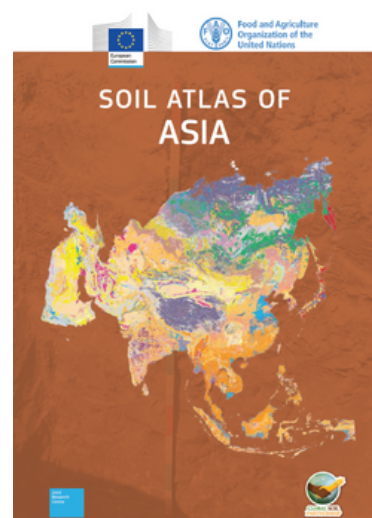


and Vietnam, and nine international organizations, e.g. FAO, IRRI and WorldVeg to jointly address the common challenges facing global agriculture through implementation, management, funding and coordination of multilateral projects, international trainings, workshops, and symposia.

One of AFACI's regional projects with notable outcomes was in postharvest technology, which aimed to minimize losses of horticultural crops after harvesting through the development of a postharvest management technology manual and its dissemination through the established network among Asian countries.

Likewise, through its Agricultural Technology Information Network, AFACI established a network and web-based information database system for agricultural knowledge information sharing through publication and distribution of agricultural books and crop calendars, through various communication mechanisms, including social media.

Moreover, projects on integrated pest management and the establishment of a prevention network for migratory pests helped in the improvement of farmers' productivity by implementing and disseminating information on efficient pest management across the region. Another salient accomplishment was the compilation and harmonization of soil information data for the continuous build-up of national soil profile database of AFACI member countries, which is necessary for agricultural research and planning to increase soil fertility and crop productivity. This initiative resulted to the launching of "The Soil Atlas of Asia" , the first ever soil atlas for the region which presents¹a series of annotated maps that show the diversity of soil characteristics across Asia in a manner that is comprehensible to a general audience.



The Soil Atlas of Asia

Box 1

About the Soil Atlas of Asia

The "Soil Atlas of Asia" is the first ever soil atlas for the region and an important tool to promote sustainable soil management and preserve soil health. By targeting the general public, decisionmakers, politicians, teachers and even scientists in other disciplines, the atlas aims to raise awareness about the crucial role of soil health among a wide range of stakeholders, support the development and implementation of policies and instruments around agriculture, environmental issues, climate change, development assistance, urban planning, and more, provide educational material to schools and universities, and provide a baseline for further soil assessments in the region.

1. Available online at: <https://www.fao.org/documents/card/es/c/cc3298en/>

One of the key factors that makes AFACI unique is its focus on promoting sustainable agricultural practices that are tailored to the needs and conditions of its member countries. To ensure that their projects will be effective and will have greater impact, AFACI conducts consultations with its member countries and solicits concept proposals. This allows AFACI to gather information about what the member countries actually need and tailor their projects accordingly. This approach helps to ensure that agricultural practices are both environmentally sustainable and economically viable.

RDA's International Cooperation Initiatives

AFACI's commitment to understanding the specific needs of their members ensures that its projects that are effective, impactful, and help to drive progress toward the achievement of country goals. Furthermore, its emphasis on capacity building and knowledge sharing are at the centre of every activity. Through a variety of training and exchange programmes and workshops, AFACI has helped build the skills and knowledge of different agriculture stakeholders (e.g. farmers, researchers, policy makers) across the region not just in technical aspects to address key agricultural challenges, such as food security, climate change and sustainability, but also capacities to work together, think and reflect collectively on the real needs of agricultural and agri-food development. This has helped to promote innovation and improve the overall quality and productivity of agriculture in the region. Overall, the success of AFACI can be attributed to its innovative and collaborative approach, its focus on capacity building and knowledge sharing, and its commitment and focus on addressing key challenges in agriculture.



Participants during the RDA rice training

Applying Korea's success in Africa

The Korea-Africa Food and Agriculture Cooperation Initiative (KAFACI) is a multilateral cooperation body led by RDA with 23 member countries and 5 international partners that cooperates with Africa in resolving its agricultural challenges. These include, for example, increasing rice production to keep pace with population growth and urbanization (more than 6 percent per year) that has made rice the fastest growing staple food in the region. Yet, the self-sufficiency rate is only 55 percent, importing 14-15 million tons equivalent to USD 6 billion. While agriculture is a source of income for over 35 million smallholder rice farmers in Africa, it also presents a potential to employ 17 million youth. However, the seed system, cultivation technologies and production environment are very vulnerable (Jeong, 2023).





Participants during the RDA rice training

One of KAFACI's main projects is the 'African Rice Development Partnership', which jointly started with the AfricaRice in 2016 and currently consists of two components. The first is 'Enhancement of high-yielding rice germplasm and breeding capacity of rice producing countries in Africa' in which AfricaRice carries out the pre-stage of breeding by crossbreeding excellent lines and fixing traits using Korea's Tongil-type rice breeding lines and genetic resources from AfricaRice. A total of 1,701 lines have been provided to member countries to date, along with training of 29 African rice breeders.

The other component is the 'Development of High-Yielding Grain Quality Rice Variety', in which each member country conducts crossbreeding and characteristic evaluation of the lines selected and provided in the previous task, and national variety registration is made through local productivity and regional adaptation tests. To date, 26 varieties have been registered in eight countries.

These achievements and implementation methods received great attention worldwide through the YouTube video 'Africa falling in love with the Korean rice variety, Tongil', and were adopted as OECD Observatory of Public Sector Innovation in 2021. The KAFACI's Africa Rice Development Partnership Project has been successful as a result of innovative international cooperation model through triangular cooperation (KAFACI-AfricaRice-Member Countries). The process of utilizing a wide range of genetic resources in Korea and member countries, selecting excellent lines by breeding experts from international institutions using specialized technologies, such as anther culture, strengthening breeding capacity through intensive training, and applying local breeding technology in member countries are closely linked, making the project more effective.

2. Available online at: <https://www.youtube.com/watch?v=zPBc95i-rgA>

Bringing Korea's experience to Latin America

Since 2014, Korea-Latin America Food & Agriculture Cooperation Initiative (KoLFACI) has partnered with 12 Latin American member countries, namely: Bolivia, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Nicaragua, Panama, Paraguay and Peru. KoLFACI has completed projects in:



- Demonstrating improvements in rice productivity through the utilization of appropriate water management systems;
- Improving soil cultivation environments through the efficient use of organic matter and biological fertilizers;
- Establishing advanced models for post-harvest quality management of horticultural crops in Central and South America, and;
- Setting up soil environment information systems in Central and South America.

Currently, KoLFACI facilitates research cooperation through various ongoing research projects, such as:

- Developing drought-resistant bean varieties to respond to climate change;
- Studying optimal cultivation methods to reduce greenhouse gas emissions from agricultural lands in Central and South America;
- Researching transplanting and sowing systems for sustainable expansion of smallholder coffee production;
- Enhancing soil fertility and crop productivity through the composting of livestock manure, and;
- Improving productivity through the selection of superior cacao varieties and climate-adaptive production systems.

KoLFACI, in collaboration with its member countries and international organizations (e.g. Alliance Biodiversity International – CIAT, and Tropical Agricultural Research and Higher Education Center – CATIE), has been generating results to address agricultural issues. It has developed agricultural technologies accessible to small farmers, thereby contributing to the enhancement of crop productivity. Improvements include improving rice irrigation facilities, promoting coffee transplanting technology, and upgrading cacao variety selection and cultivation technology (with a production increase from 200kg/ha to 229kg/ha, or 11.5 percent).

The cooperation is continuously developing agricultural technologies to build a Latin American agricultural foundation able to respond to climate change. Developments include techniques for reducing water usage in rice cultivation in response to climate change (saving between 14-40 percent per country), constructing a soil information foundation for sustainable agriculture, developing drought-resistant frijol varieties, and researching cultivation methods to reduce greenhouse gas emissions from agricultural lands.

KoLFACI also operates training programmes to enhance the expertise of specialists from member countries in Latin America in the field of agricultural technology. It offers training programmes in South Korea to disseminate its best domestic agricultural technologies and provides training on-site in various countries tailored to the needs of individual projects and farmers. Furthermore, KoLFACI is working to establish an education system to strengthen the capabilities of small farmers in Latin America. This includes developing and distributing technical manuals usable by small-scale farmers and offering on-site educational programmes for farmers.

Lessons learned from international collaborations for Korean NARS

The RDA has made great strides in improving the country's agricultural sector after the Korean war that left the country with food insecurity and poverty. This story has highlighted South Korea's unique capacities and experiences that it gained from its rapid transition from a recipient of development assistance to a developed high-income country with efficient NARS. Now, South Korea is sharing its success by engaging in international cooperation and sharing knowledge, technologies and innovations with other NARS in the developing world.

Innovation has been a crucial aspect in South Korea's rapid agricultural and economic development and in its collaboration with other countries; it strives to bring new ideas to the forefront and inspire new ways of thinking and problem-solving. South Korea learned that such innovative partnerships and knowledge sharing are priceless as they enable different experts from around the world to share their unique knowledge and experiences to improve their countries' agricultural sector as a whole.

The RDA has been able to learn from international experiences and adapt successful practices to the Korean context, which has allowed the RDA to avoid potential pitfalls and accelerate the adoption of new technologies and techniques. By embracing innovation, the Korean NARS can keep up with the ever-evolving needs of the agrifood sector and stay ahead of the competition. Building strong relationships based on trust and mutual respect can overcome language barriers and cultural differences, and lead to more successful collaboration outcomes.

The RDA's international cooperation initiatives have provided valuable insights and lessons that can be applied to other NARS. By embracing these principles, Korean agriculture, through the RDA, can stay at the forefront of agricultural research and development to improve the lives of farmers and communities while maintaining its position of success in the global scale.



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Authored by

Asian Food and Agriculture Cooperation Initiative (AFACI)
Korea-Africa Food and Agriculture Cooperation Initiative (KAFACI)
Korea-Latin America Food & Agriculture Cooperation Initiative (KoLFACI)

Editors

Martina Spisiakova, APAARI
Pooja Mathur, APAARI
Aiden Holley, FAO

Technical writers

Ms. Marjorie M. Mosende, AFACI Secretariat
Dr. Park Soo-Yun, AFACI Secretariat
Mr. Hwang Rokyeun, KAFACI Secretariat
Ms. Han Eunjung, KoLFACI Secretariat



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