R&D Policy for Agri-Food in Korea

Byoung-Hoon Lee

INTRODUCTION

Korean agriculture has been facing many challenges including its sluggish growth opening of market, climate change, and energy and resource shortage problems. Korean government has continually expanded investments in agri-food sector's R&D to give appropriate solutions to these challenges and hopefully lead to agricultural growth. This article introduced and reviewed the R&D activities and system for agri-food in Korea.

Present situation

Three organizations such as the Ministry of Agriculture, Food and Rural Affairs (MAFRA); the Rural Development Administration (RDA); and the Korea Forest Service (KFS) regularly conduct R&D investments for the agri-food sector. R&D budget for MAFRA, RDA and KFS has increased annually by 7.7% while that of the national R&D budget has gone up by 8.2% in the recent seven years. In the meantime, the total expense of MAFRA, RDA and KFS has increased annually by 2.7% during the same period from 2008 to 2014.

Table 1. Share of R&D Budget of Ministry of Agriculture, Food and Rural Affairs, Rural Development Administration, and Korea Forest Service

Unit: 100 million won

Classification	2008	2009	2010	2011	2012	2013	2014	Average annual increase rate
R&D budget of MAFRA, RDA, and KFS (A)	5,709	6,257	6,699	7,463	7,983	8,439	8,934	7.7
National R&D budget (B)	110,784	123,437	137,014	148,902	160,244	171,471	177,428	8.2
Total expense of MAFRA, RDA, and KFS (C)	142,756	151,434	155,040	159,584	163,454	164,443	167,256	2.7
A/B (%)	5.2	5.1	4.9	5.0	5.0	4.9	5.0	
A/C (%)	4.0	4.1	4.3	4.7	4.9	5.1	5.3	

Another characteristic of R&D investments area in the agri-food sector is that instead of the private sector, it is the public sector which is the main investor of R&D for agri-food.

In 2012 the total domestic R&D investments is about 55.45 trillion won, which included the private sector's investments, among them R&D investments regarding food, agriculture and forestry which accounts for 2.3% (1.25 trillion won).

The R&D expenditure in the agri-food sector which is owned by private enterprises was 424.9 billion won. This accounts for 33.9%, and its share was smaller than that of the public research institute which accounts for 540.8 billion won (43.2%). We can say that the share of R&D expenditure by private enterprises is very low in the total R&D expenditure of the nation in 2012 (424.9 billion won of the total 55.4 trillion won).

The present status of domestic R&D investments in the agri-food sector in regard to the seven related sectors of the First Comprehensive Plan show that the biotechnology sector. (of which investments expanded most from 2009 to 2012), increased by 29% in annual average.

Table 2. Variations of agricultural R&D investments in seven major sectors

Unit: 100 million won, %

Classification	2009		2010		2011		2012		Average yearly increase rate
	Invested amount	Share	Invested amount	Share	Invested amount	Share	Invested amount	Share	
Production system	972	13.7	984	12.7	934	10.8	698	7.7	-10.5
Resource/environment/ ecological base	724	10.2	1,075	13.9	926	10.7	868	9.6	6.2
Production/processing	1,440	20.3	1,920	24.9	1,674	19.4	1,628	17.9	4.2
Distribution/food product	451	6.4	868	11.2	637	7.4	684	7.5	14.9
Bio	457	6.5	750	9.7	823	9.6	982	10.8	29.0
IBNT convergence	316	4.5	117	1.5	175	2.0	284	3.1	-3.5
Culture	101	1.4	105	1.4	117	1.4	100	1.1	-0.3
Others	2,624	37.0	1,900	24.6	3,329	38.6	3,841	42.3	13.5
Total	7,084	100.0	7,720	100.0	8,615	100.0	9,085	100.0	8.6

Note: The amount includes investment in fishery products.
Source: Korea Institute of Planning & Evaluation for Technology in Food, Agriculture, Forestry & Fisheries.

R&D focus and core technologies

In 2013, there were three main organizations related to R&D investments which got involved in the agri-sector. They are the Ministry of Agriculture, Food and Rural Affairs, the Rural

Development Administration, and the Korea Forest Service. Recently these organizations announced the "Mid-and-Long Term plan for Agri-food Science & Technology Development (2013-2022)" with four major R&D areas evaluated in order to 1) increase global competitiveness, 2) create a new growth power, 3) supply food in a stable manner, and improve national welfare. Like the opening of the Korean agricultural market and climate change, the plan reflected the R&D environment, and the philosophy of the Korean agricultural policies which basically aims to achieve a creative economy and maximize the utilization of the Korean people.

Strengthen the global industrial competitiveness

The aim of strengthening the global industrial competitiveness is to be more competitive by developing a technology-intensive and ICT-based agri-food industrial sector.

Aim of plans

• Agri-food Exports Increase: $5.6 billion in 2012 → $10 billion in 2017→ $15 billion in 2022

• Added Value: ₩56 trillion in 2012→ ₩67 trillion in 2017 → ₩77 trillion in 2022

For that, investments will be concentrated on developing technologies to strengthen the industrial competitiveness to prepare a liberalized Korean agricultural market by the 45 FTAs in 2013 and be more competitive in the global market. Technologies have to be developed & updated to promote welfare (including health) of the public by liking the agricultural and livestock industry to the food industry, and technologies that are smart, automated, and converged with ICT to address the problems caused by decreasing rural population and increasing agricultural management costs.

Table 3. Core technologies to strengthen global industrial competitiveness

Classification	Core Technologies
Response to FTAs	Eco-friendly, integrated livestock waste treatment technology
	Advanced, eco-friendly livestock shed development for animal welfare
	Technology for improving livestock product quality and productivity
	Storage and distribution technology for fresh agricultural and livestock products
	Cultivation of new high-quality horticultural varieties to respond to royalty and for export
	Management cost reduction and productivity improvement technology for faculty horticulture
High value-added food	High value-added beneficial food development technology
	Commercialization technology for high-quality/high-income fermented foods
	Freezing and defrosting technology for agri-food freshness maintenance and long-term storage
	Integrated production management system for food processing efficiency improvement
ICT convergence	Robot-based technology for agricultural and livestock products
	Technology for state-of-the-art intelligent precision agriculture

	Commercialization technology for eco-friendly and smart(fully controlled) plant factories
	Integrated intelligent control system for agricultural irrigation

Find other ways for growth

The passion to seek a creative way for growth will be able to help create new markets by developing a new material industry which is agri-based.   In this way, people will be able to appreciate the goals of agricultural development: to create an eco-friendly environment and increase the quality of life.   In the process another goal is to become a powerful nation in the energy sector via developing and industrializing energy through agriculture.

For that, the government has to conduct the establishment of a system which produces technology support which can cover all of the sectors, so they can contribute to the promotion of the agricultural and bio-industry such as agricultural genome, new biological materials and bio-food and drugs.

Performance Targets
• Domestic production in the new biological material industry:
  10 trillion in 2012 → \15 trillion in 2017 → \20 trillion in 2022 (100%↑)
• Renewable energy:
73,000 TOE in 2012 → 618,000 TOE in 2017 → 1,163,000 TOE in 2022 (1,493%↑)
· Share of biomass in the total energy production: 10% in 2022

Table 4. Core technologies to accelerate growth

Classification	Core technologies
Agricultural & new biological materials	Technology for antibiotic-reducing natural alternative materials development
	Environmentally harmful element-free bio-plastics
	Beneficial amino acid materials development and mass production
	Eco-friendly new materials development from wood resources
	Customized digestion-improving natural materials development
Agricultural & biological food and medicine	Materials development for food and medicines from agricultural & biological resources
	Development and commercialization technology for animal bio xeno-transplantation
	Mass production and control technology of animal protein for food and medicine
Agricultural & biological genome	R&D technology for agricultural genome information service
	Investigation and utilization study of useful gene characteristics
Golden Seed Project	Development of excellent seeds for strategic exports and alternatives to imports
	Highly efficient seed production and processing system for seed commercialization
Agriculture and rural village energy	Mass production technology for bio resource crops
	Highly efficient production technology for bioenergy
	Technology to use wood bioenergy and wood elements

Stable food supply

To achieve a stable food supply, those, who work in related R&D investments in the agri-sector, have to develop programs that will promote a sustainable agriculture industry that can endure climate change. It also needs foundation for safety of livestock production through the establishment of a strict immune system for livestock.

Performance targets
• Reduction in greenhouse gas emissions: 0% in 2012 → 7.1 % in 2022
• Securement of a position as an infectious livestock disease-free nation

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For that, the government has to focus and invest in order to develop technologies that would enhance productivity and quality of grains, addressing issues like unstable amount of supply and demand of crops and food resources.

Table 5. Core technologies for stable food supply

Classification	Core technologies
Improving the grain self-sufficiency rate	Development of staple grain varieties with high quality and productivity and technology for improving stable production
	Technology to improve productivity of field crops
	Technology for mass production of functional forage with high-productivity
Response to climate change	Development of climate change-adapted varieties and of their production technology
	High-tech, real-time climate disaster prediction system for agriculture and forestry
	Technologies to establish the foundation for predicting and assessing the impact of climate change for the agricultural, forest, and livestock sectors
Prevention from disaster and disease	BIT-converged, rapid diagnosis technology for disease and pest
	Epidemiologic investigation technology for agriculture, forest, and livestock disease
	Technology for prevention and treatment of livestock disease including communicable disease between men and beasts
	Establishment of an internationally integrated quarantine system for agricultural, forest, and livestock disease

Plus, the government should enhance technologies to address issues like uncompetitive crop productivity. It also needs to seek suitable farmlands to prepare for climate change and global warming.

Improve the nation's welfare

The aims to improve the national welfare are to reform the countryside into better working and resting places via reinventing those regions, to promote urban farming where agricultural resources such as livestock and foodstuffs co-exist, and to establish the foundation that works to produce, manage and provide a stable supply of safe agri-food.

Performance targets
- Rural residents' satisfaction level for the quality of life: 50 points out of 100 in 2012 → 60 points in 2017 → 65 points in 2022 (30%↑)
- The number of beneficiaries of forest welfare services: 11 million in 2012 → 20 million in 2017 → 30 million in 2022 (172%↑)
- Construction of urban forests in living zones: 8㎡ per person in 2012 → 9㎡ in 2017 → 10㎡ by 2022 (25%↑)
- Agricultural/livestock produce with environmentally friendly certification:7%/12% in 2012 → 9.5%/15% → 12%/20% in 2022

For that, government tried to push its efforts not just to develop technologies that help increase incomes. In the non-farm sector, the government also made efforts to preserve the

traditions of rural communities and promote the urban conditions through the development of certain agricultural disciplines like landscaping.

Table 6. Core technologies for improvement of national welfare

Classification	Core Technologies
Value improvement of agricultural and rural villages	Technology for preservation of rural landscape and traditional resources and for cultural content production
	Safety management technology for farmers
	Technology for establishment a green town utilizing urban green technology
	Technology for supporting agriculture settlement for peoples returning to farms
Forest management advancement	R&D technology for forest welfare services
	High value-added forest resource creation and cultivation technology
	New variety development and cultivation technology for forestry income sources
Safe food production	Technology for safe agri-food production and hazard control
	Technology for establishing a life-cycle livestock production safety control system
	Technology for product safety investigation and quality control at the agri-food production stage

Main achievements of R&D policies in agri-food sector

There are several achievements that R&D investments has set out in the agri-food sectors. They are as follows:

First, thanks to increased investments in the agri-food R&D, the level of technologies in the sector has been enhanced. While the total amount of budget in the agri-food sector increased by 2.7% in the recent seven years (2008-2014), the budget for R&D expanded by 7.7%, which is an annual average amount, in the same period. The share of R&D has been raised generally in related sectors.

Second, the groundwork which aims to create a more effective R&D through policies related to groundwork has been improved. The Office of Strategic R&D Planning for Climate Change was set up in 2011 and followed joint surveys about demand for technology based on the groundwork.   The objective is to make effective R&D investments.

Third, a system for commercializing technology was created throughout the whole stages-- from an R&D commencement and intellectual property protection acquisition stage to a technology transfer and trade stage, to a market entry and maturity stage. The private investments environment for R&D by agri-food companies was created by expanding projects to commercialize technology and by introducing the "R&D fund." Early commercialization of technologies was achieved through expanding opportunities for private enterprises to participate in R&D projects which was carried out by the government. The participation rate of private companies in the national R&D projects for agri-food areas increased from 25% in 2012 to 32% in 2013.

CONCLUSION AND POLICY IMPLICATION

Despite these achievements, many problems exist in the R&D of agri-food in Korea as follows: shortcomings in linkages between agri-food policies and R&D; limitation of the Science and Technology Commission of Food, Agriculture, and Forestry as a control tower that leads to innovations in agri-food science and technology; limited investments of private organizations and companies in R&D; the weak regional base for R&D; insufficient research for convergence with ICT, BT, and NT; and unsatisfactory level of and immature conditions for commercialization of technologies.

Finally, in order to overcome these problems in R&D of agri-food and maximize these achievements, the government has to efficiently develop and use food, agriculture, and forest resources by establishing infrastructure for the development of science and technology and work out systematic measures to facilitate the sound development of the food, agricultural, forestry industries and create a better quality of life for the public.

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