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ABSTRACT

South Korea, which suffered from severe hunger and poverty after the Korean War (1950~1953), has achieved self-sufficiency in supply of rice, a staple crop, since the early 1970s with the success of research and development, and extension services in the agricultural sector. The country has unique characteristics in its Agricultural Extension Services (AES), currently organized as the Rural Development Administration (RDA), compared to other countries and they have brought about significant success in improving agricultural productivity and efficiently providing developed technologies to farmers. This study has been performed to study AES in Eurasian countries as well as the development of the agricultural extension system of Korea in order to share the successful factors that enabled South Korea to accomplish such success in the agricultural R&D and technology distribution.

This paper consists of four main parts of research. The first one is the development of the distinguished agricultural extension services of Korea in the perspective of policies and institutions. For the efficiency of AES, the Korean government combined research and development, and extension functions into one independent government body. RDA had four agricultural institutions of science and four extension-related bureaus and it could make synergy effects of the combined functions through the interaction during extension services with farmers who adopted new techniques and technologies provided by RDA. In the process, R&D and extension services could coincide.

The second part of the study covers the Korean agricultural transformation which explains the changes in the agricultural sector over the past decades and suggests new directions for the role of agriculture in Korea. Due to the industrialization and modernization, diet habit and food consumption were diversified. Strategies and directions to revitalize rural communities including the restoration of rural areas, decentralization, investment in innovative growth in rural communities are provided.

The third part of the study represents the current nutritional status and agricultural R&D and extension system of Eurasian countries. Since the independence in 1990, Eurasian countries developed and organized their own agricultural extension services in order to improve agricultural productivity and increase farmers' income. The Eurasian countries which this study covers have operated not only national institutes of agricultural science but also educational institutions such as universities for the development of agricultural technologies. While a diversity of institutes are organized and play a critical role in R&D and extension services, such issues as lack of budget and well-trained extension workers, and too much dependence on international donors arise in the countries as problems.

Lastly, the study delivers implications for AES of the Eurasian countries based on the findings from the case of the Korean extension services. Eurasian countries may have issues including lack of public investment, limited contributions by donors, and actors in R&D and extension services. For the efficiency of AES in the region, the study suggests the efficiency in coordination of functions between R&D and technology dissemination, extended involvement by the public sector, and extensive involvement of the extension services other than traditional functions of technology dissemination.

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Introduction

Background

Since the latter part of 2017, the World Bank and the Eurasian Center for Food Security (ECFS) of Russia have jointly initiated a multi-country study on Food and Nutrition Security in the Eurasian Region. The study has the objectives “1) to generate evidence to support government policy aimed at the transformation of existing agricultural and food systems in selected Eurasian countries to improve national and household incomes, food security, diets and nutrition in a manner compatible with sustainable management of natural resources; and 2) to facilitate policy dialog, including consultations and workshops, for the purpose of integrating the evidence generated by the study into the policy debate and decision” (cited from the World Bank’s terms of reference for the ‘Study on Agricultural and Food Systems Transformation for Better Food Security and Nutrition in Eurasia’, 2017).

The Korea Rural Economic Institute (KREI), a government-sponsored research institute of the Republic of Korea, joined the conference and workshop meetings in Moscow related with the study. KREI contacted policy-makers and

researchers in six Eurasian countries who participated in the study, and has looked for the research area which it could be contributory, and, basically, would be useful for study teams.

It was decided to introduce historical evolution of the agricultural technological research and extension system of Korea to offer useful implications in suggesting policy recommendations for the Eurasian countries' food security and nutrition. Since the early 1960s, Korea has developed efficient public R&D and advisory service systems in the agricultural sector. With other policy supports, the public administrative body, Rural Development Administration (RDA), has contributed to full self-sufficiency of staple crop, rice, and to the commercialization of horticultural and livestock products.

Purpose of study

The study has been conducted to provide rationales of the needs of government-supported agricultural research and development (R&D) and extension services based on the Korean experiences to Eurasian countries. The R&D and extension services are essential for food security and nutritional improvement. This paper addresses the history and evolution of the agricultural research and extension system in Korea, introduces the achievement of food security and nutritional transition, and offers a few implications to the Eurasian countries.

Due to the fact that many parts of this study focus upon Korean experiences of the agricultural R&D and extension system since the 1960s up to the late 1990s, descriptions about the changes since the early 2000s and current situation will be minimized.

Chapter 2

R&D and Extension System of Korean Agricultural Technology

1. Evolution of Organizations and Institutions

Korea's system of agricultural R&D, extension and dissemination has been developed in order to play the roles and functions that are supposed to be done by public institutions. Before the 1970s, Korea suffered from persistent food shortages after the Korean War and had to depend on food aid such as PL480 provided by the US. In this situation, the nation's key task was to increase the production of food crops especially the staple crop, rice. From the mid-1970s, the nation achieved a sustainable self-sufficiency in rice through the Green Revolution. In the 1980s, there was a big achievement, the so-called White Revolution which created various agricultural technologies to increase production of economic crops, other than rice, including horticultural crops such as fruits and vegetables for raising rural incomes.

The Korean agricultural research and extension system is unique in that it has successfully combined the technology development functions with

technology distribution and extension functions within one organization. The Rural Development Administration (RDA), a central and independent government body for agricultural technology R&D and extension, has been a main agency for the whole policy development and implementation since the early 1960s and, at least, until the late 1990s in Korea. It has linked vertically different levels of organizations from the national center down to the rural townships and villages.

After the Korean War from 1950 to 1953, a diversity of international assistance organizations put great importance on agricultural development addressing the urgency of implementing Agricultural Extension System/Services (AES). The report, known as 'Macy Report' written by Dr. Harold Macy in the late 1950s, contemporary Dean of College of Agriculture of Minnesota University, requested by United States International Cooperation Agency (ICA), advised that extension organizations and agricultural experiments department should be separated from the administrative body, but they should work together (Ko et al., 2014).

〈Table 2-1〉 Development of the AES in Korea

Organization	Characteristics
Japanese Colonial Period (~1945)	■ Branches at central, provincial, and local level ■ Most of Japanese technicians left Korea after the end of the 2nd World War
Institute of Agricultural Improvement, IAI (1947~1949)	■ Benchmarking university curriculum of the United States - College of Agriculture (particularly, Seoul National University), National Agricultural Extension Bureau and Agricultural Experiment Stations under the MOAF - Unifying diverse organizations to national agricultural institutes - Separating local extension offices from the local administration bodies
Institute of Agricultural Technology, IAT (1949~1956)	■ Returning supervision authority of university to the MOE - Organizing Technical Dissemination Bureau: Production Department, Technology Management Department, and Training Department - Abolishing the bureau in January 1954 and Management Technology and Training Department devolved to Experiment Division II ■ Considering the unique characteristics of the Korean agriculture ■ No effective implementation of the AES due to the Korean War
National Institute of Agricultural Technology, NIAT (1956~1957)	■ USICA assisting the Korean government built up the fundamental basis of AES - Signing 'Agreement on Development of Agricultural Extension Services' - The Agricultural Extension Law passing the National Assembly in 1957 ■ The integration of local extension organizations with the local administration bodies - Extension Bureau: Planning Department, Training Department, Agriculture Department
Institute of Agriculture (1957~1962)	■ Agricultural Extension Law enacted according to the Macy Report - Separation of local extension offices from the local administrative bodies which led . to centralized extension system - Extension Bureau: Extension Policy Department, Technology Diffusion Department, Rural Youth Department, Rural Home Domestic Department ■ Empowering skilled extension personnel - Executed extension services based on bottom-up process
Rural Development Administration (1962~)	■ Integrating quasi extension programs for the implementation of rural development - Rural Guidance Bureau: Planning Department, Agricultural Improvement Department, Rural Affairs Department, and Communication and Information Technology Department ■ Placing local extension office as an independent entity but under the local government - Cooperation on extension services between the central and local governments ■ Extension department unit established in 1989 at city/district level to execute only extension-specialized services - A couple of the departments based on the situation of districts ■ AES decentralized in 1997 - Supervision authority related to budget & operation of extension entity and personnel management transferred to the mayor of local government - The implementation of AES considering the characteristics of services areas

Source: RDA (2004).

The Macy Report provided the fundamental basis for the establishment of modern, democratic, and scientific administration for agricultural R&D and extension services. It also led to an 'Agreement on Development of Agricultural Extension Services' signed by the government, National Assembly, and the ICA. It includes 1) the establishment of an institute based on law, 2) promotion of the project and organizing a clear structure of administrative body, 3) provision of the necessary budget from the National Assembly, and 4) hiring well-trained personnel politically neutral in the institute. According to the agreement, ICA purchased necessary materials for the project and helped invite American specialists to Korea for providing technical assistance.

The National Assembly passed the law named 'Agricultural Extension Law' in January 1957, which was intended for the successful and institutional implementation of AES. It helped local extension organizations independent from administrative bodies and secure training of professional personnel, and extension services which were bottom-up oriented educationally. Although various problems including the budget issue were solved, there remained still several problems during the preparation procedures, such as 1) confusion about complicated administrative order chains, 2) inefficiencies in implementing a variety of projects, and 3) issues over autonomy and its educational nature (Chung, 1999).

In November, 1961, the Committee for Unifying Agricultural Extension System/Services (AES) was established by MOAF complying to the order from the military government for dealing with the issues including inefficiency and confusion derived from disorders of administrations. After a series of meetings for unifying AES, majority of the committee preferred the way of AES integrated into the general administrative body not separating AES from the general administrative

government. The committee failed to consent one proposal. This led MOAF to submitting the plan supported by the majority to the National Assembly in January 1962.

In addition to the agricultural extension offices at the level of cities and counties, 1,473 township branch offices were established by 1975, thereby completing the technology dissemination and extension system that could cover farm households at the level of villages. The number of personnel working for the offices rose to 7,628 in 1977 (Ko et al., 2014: 45).

2. Organizations and Functions

Two functions of R&D and extension under one roof

AES in Korea is classified as a government-funded system based on its financial perspective. The Rural Development Administration (RDA) that executed AES was established by the government but as a body independent from the Ministry of Agriculture and Forestry (MOAF). The 'Rural Development Law' (1962) allowed the RDA administrator to manage the personnel in the provincial government for the concerns with agriculture-related activities. Three main duties of the RDA are listed as follows: 1) executing research and development for the improvement of agricultural technology, 2) transferring knowledge and technology for agricultural production for the improvement of agriculture and rural areas, and 3) training farmers, rural youth, student and teachers, and local leaders as well as extension workers in agricultural technology and extension offices.

〈Table 2-2〉 The Main Functions of Rural Development Administration

Classification	Mission	Beneficiaries
Research & Development	- Improving agricultural technology development	food crops, horticulture, livestock, veterinary medicine, sericulture and farm machinery, etc.
Knowledge & Technology Sharing	- Transferring agricultural knowledge and technology for the improvement of agriculture and rural life	farmers, rural community, farmer's organizations
Educational Trainings	- Providing educational training courses	farmers, rural youth, students and teachers, local leaders, and extension officers in rural branches

Source: RDA (2004).

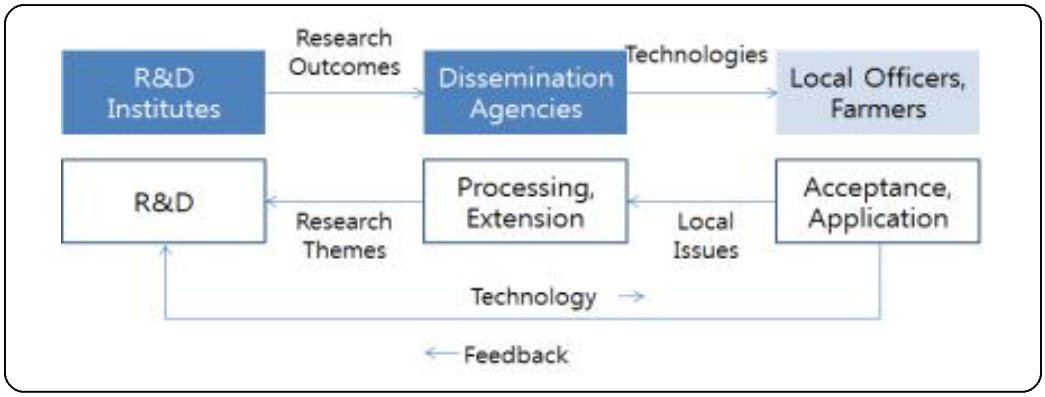
The RDA focused on the function of R&D and AES, excluding the function of education. The organizational structure of the RDA at its early period was as follows: the Extension Service Bureau, the Research Management Bureau, and the Technology Transfer Bureau in the main body, and ten research institutes dealing with development of new varieties and suitable technologies.

The RDA operated nine provincial RDAs (PRDAs) for transferring new technologies to farmers and providing trainings and extension services to rural communities. PRDAs were linked with lower levels of organizations: Agricultural Extension Office (district) and branch offices of Agricultural Extension Office (township), were hierarchically linked to the central RDA.

One of the special characteristics of the Korean AES system is that the AES implementation organization, the RDA, executes both R&D and AES functions while other countries such as Japan, Thailand, and the Netherlands completely separate the research from the extension. Implementation of both functions led the RDA to diffusing research results and innovative technologies easily and quickly through training of extension

workers and growers (Choi, 1995). Extension department personnel were agents, whom the government systematically trained to produce specialized experts, and they delivered effectively the new technologies created and developed in R&D departments of central and provincial RDA systems to reach fields and farmers (RDA, 2004).

〈Figure 2-1〉 Efficient Integration of R&D and Extension Functions



Source: Ko et al. (2014: 48).

Independent and monopolized position of extension services

Another point is that the effectiveness of the two different functions could be increased because the extension workers at local level were independent of the local government administrative system, until the late 1990s. RDA was solely given the authority by law to manage and approve for other organization's business to the agricultural extension, which made it possible for it to coordinate all extension-related projects.

The separation of administration and R&D and extension was specified in the related laws, and thus the human resources were not allowed to be engaged in other works other than their own project tasks (Ko et al., 2014: 51). Although they worked closely with local administrative office, head of RDA had authorities over personnel affairs,

for instance, positioning and appointment, and salaries of the extension workers, which exempted them from routine implementation of administration chores.

Extension workers played a bridging role between farmers and administrative bodies and it helped increase the motivation and dedication to work by the extension service workers. The total number of extension workers at RDA, PORD, and city and country level increased significantly from 952 in 1957 to 7,980 in 1980. The workers were stationed at the places where farmers and teachers needed supports for their agricultural activities (The Manual of Agricultural Extension Service, 1983).

〈Table 2-3〉 Number of Workers of RDA

Year	Total	RDA	PRDA	District Extension Office		
				Total	Headquarter	Branch
1957	952	82	177	693	693	-
1962	3,173	75	180	2,918	2,918	-
1970	6,360	73	236	6,051	2,882	3,169
1980	7,980	106	226	7,648	2,997	4,651

Source: The Manual of Agricultural Extension Service (1983).

Since the late 1990s, as the economic contribution of the agricultural sector has shrunken and fewer people were engaged in farming activities, local human resources under the RDA system were incorporated into agricultural technology centers in local governments of cities and districts. Currently, RDA operates its central and provincial organizations, still maintaining its status as one of central public administrative bodies.

Multiple role-taking by RDA workers

Besides, dissemination of agricultural technologies, the noteworthy aspect of Korea's extension system was its involvement in the enhancement

of rural living conditions (Lee, 2010: 27).

The extension workers' role as rural development consultants had been played since the Community Development (CD) project, in the late 1950s. RDA executed the CD project immediately at its start (Chung, 1999). Therefore, extension agents implemented this demonstrative rural development projects also, residing in model villages to carry out a wide range of activities: disseminating technologies; conducting studies on the status of villages; planning the village development strategy; and improving the livelihoods of rural areas (Ko et al., 2014: 42).

They carried out surveys, organized community groups (development committee), collected opinions from residents, designed development plans, conducted self-development and aid projects and improved living conditions of residents (Yoon et al., 2013; Chung, 1999: 2074~2075). With residing agents, rural villages were strongly willing to employ new science and technologies for agricultural management and had high level of techniques for cultivation of major crops, with higher average income per household than other villages (Ko et al., 2014: 72~73).

Later, in the early 1970s, the Community Development project conducted by the RDA was incorporated into the nation-wide national campaign of Saemaul Undong (New Village Movement) (Lee, 2010: 35). Saemaul Undong, which is known as a top-down rural development initiative or campaign, enthusiastically supported by top leader, President Park Chung Hee since 1971 onward in Korea, included diverse components besides the disseminating new agricultural technologies and varieties (Park, 1998).

During the winter season which is the agricultural off-season in Korea, other income source-related activities and education for illiteracy eradication were provided. Training program intended to transfer the spirit of diligence, cooperation, and self-help as well as cultivation technologies

of new varieties were planned and executed. These programs were expanded to target female rural residents, the elderly and consumers, and included development and utilization of material resources in rural areas (Lee, 2010: 67).

Rural development activities included management of various social organizations: farmers' collective groups, 4H, rural leaders, women, the elders, etc. Home economics service or rural living and resources development services had been other important tasks, for instance, kitchen cooking using methane gas, baby sitting in busy season, roof and house renovation, drainage cleaning, community drinking water source development, community facilities, etc.

In addition, nutritional improvement was regarded as a key area of interest for the RDA. The Rural Nutrition Institution was established under the RDA in 1978 to improve dietary life and nutrition in rural areas. The name of this organization changed to the National Rural Living Science Institute in 1994, and has been in charge of technology development and education to apply science to rural life. Projects in the 1990s include employment of female rural residents, improvement of farming conditions and health management (Lee, 2010: 77).

For this, the authorities have made much effort to secure professionalism of human resources for education. RDA workers were classified by the type of crops—grains, vegetables and fruit and by the type of functions—farm management, living conditions and social development for more professional technology education (Ko et al., 2014: 51~52). This system contributed to enhancing capabilities of instructors and human resource management as well as covering various issues for agriculture and rural development.

3. Performances for Food Security and Nutrition

Enhanced Agricultural Productivity

RDA's efforts toward technological innovations have produced many positive performances. Rice productivity increased from 2.33 tons/ha in the 1960s to over 5 tons/ha in the mid-1970s, accomplishing so-called 'Green Revolution' in Korea. Other technology development includes artificial insemination of cattle, commercialization of vegetables through greenhouse cultivation, and organic fertilizers for environment-friendly farming, to name only a few (Suh, 2007).

Since Korean War until late the late 1960s, the amount of imported rice steadily increased, because of the low productivity and the exploding population and consumption, as well as disease and insect pest, and vulnerability to climate-induced disasters. It is axiomatic that Korea was highly dependent on importing of rice, 26 million dollars, in 1971 while the amount of its export was 1,067 million dollars (Ko et al., 2014).

The development of high-yielding rice varieties--Tong-il variety, which is a result of hybridization of indica and japonica varieties between the late 1960s and early 1970s resulted in substantial increase of rice productivity in the mid-1970s in Korea to the level of 'Green Revolution'. Its productivity was more than 5 tons/ha and its resistance to pest and disease was strong enough to produce the target amount of rice as planned.

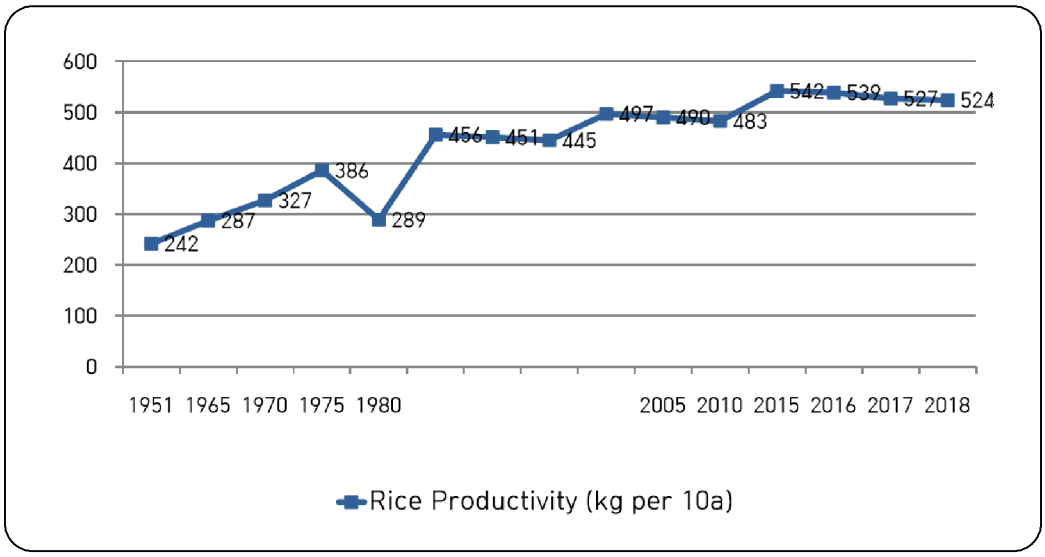
With this new variety, the nation achieved rice self-sufficiency in 1974. The rice field area in which the new variety was planted covered 78.1% of total area in 1978, and the average rice production of farm households reached the world's highest level of 4.94 ton per ha in 1977. This year, the supply of rice surpassed the demand by recording 108.6% of

rice self-sufficiency rate (Kim et al., 2012: 21).

The new rice variety development resulted from international cooperation that technology personnel of the RDA lengthened the test cultivation period to winter season by utilizing the pilot packaging process of the International Rice Research Institute (IRRI) located in the Philippines. Rice seeds, high yielding varieties, were multiplied in the Philippines during the winter, and delivered to Korea by air in the early spring.

The government made the rice price stable by buying up, leading to the farm household incomes higher than that of urban workers in the mid-1970s. And other technology development such as protected rice nursery, and development of related industries, e.g. polyethylene film (vinyl) and agricultural machines, followed to support productivity improvement as well as chemical inputs like fertilizers.

〈Figure 2-2〉 Rice Productivity (kg per 10a)



Cold weather damage in 1980 temporarily affected rice yield.
Source: kosis.kr (29-11-2018).

Expansion of Horticultural and Livestock Products

After the high-yield variety creation led to self-sufficiency in rice in the 1970s, priority was transferred to development of cash crops and agricultural management to raise farm household incomes. The previous agricultural system rapidly shifted to commercial farming involving both livestock and horticultural production, including high-quality low-volume production of vegetables and fruits such as watermelon, strawberry, and leafy vegetables (Lee, 2010: 60). Accordingly, the function of agricultural extension began to change its focus to technology development for garden products like vegetables and fruits (Ko et al., 2014: 46). Greenhouse cultivation of vegetables and some fruits provided the ways of all-season year-round production and supply to the market, exploding commercialization of agriculture (Seo et al., 2013).

The vinyl mulching and tunnel cultivation techniques for cash crops such as chili pepper, sesame and peanuts had been introduced in the 1970s; however, the year-round cultivation using vinyl greenhouses started during the 1980s (Lee, 2010: 57; Ko et al., 2014: 58-59). The area of greenhouse cultivation showed a three-fold increase in the 1990s compared to the 1980s (Lee, 2010: 60).

〈Table 2-4〉 Selected Technologies Developed by RDA

Categories	Technologies
Variety innovation	Rice plug seedling technology, high-yield rice and fruits, sustainable paddy cultivation, pest and weed management, seed potato production, vegetable plug seedling production, vinyl mulching, growth control, drip irrigation, tissue culture
Livestock	Artificial insemination, automatic milking, assorted feeds, hygiene milk cooling
Machine and facility	Tiller, rice harvester, multi-purpose tractor, rice milling system, rice trans-planter, baled silage, pesticide power applicator, automatic greenhouse control system, water pump
Soil control	Balanced chemical application, soil improvement, paddy water control
New products	Cherry tomato, orchid, kiwi fruit, cactus, broiler, mushroom, occidental vegetables, organic products, greenhouse flowers, highland vegetables, dairy products, juices
Produce distribution	Cold-chain system, bar coding, automatic packing, sorting and selecting (non-destructive method)

Source: Suh (2007).

〈Table 2-5〉 Production Index of Agricultural Products

	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2017
Rice	78.2	88.0	104.3	79.3	125.6	125.2	104.8	118.1	106.5	95.9	93.4
Barley	1,373	1.466	1,492	684.6	470.1	338.4	226.6	128.3	156.6	87.5	102.0
Mixed Grain	297.3	302.6	220.4	346.6	302.5	268.5	178.0	135.7	145.7	97.5	91.5
Pulse	158.9	214.6	276.7	214.4	214.4	210.4	146.8	102.6	149.8	85.0	82.6
Potatoes	344.1	271.0	259.3	141.0	141.0	83.2	96.0	112.2	120.3	99.9	83.2
Vegetables	15.6	23.7	46.3	76.1	76.1	78.6	113.3	122.5	114.7	96.8	93.6
Fruits	8.2	11.7	18.9	55.8	55.8	63.9	81.7	92.9	100.8	96.3	101.8
Special Crops	24.5	67.5	129.3	206.4	206.4	205.0	176.6	158.6	121.1	110.5	107.7
Flowers	0.0	0.0	0.0	0.0	0.0	16.6	27.8	60.6	135.8	113.4	85.6
Livestock	23.0	39.1	99.6	64.2	128.4	72.7	180.4	392.2	157.2	107.5	101.3

Source: kosis.kr (29-11-2018).

During the 1980s and 1990s, commercialization of agriculture, centered on horticultural and livestock products, was complete.

Corn production per hectare had been 1.45 ton in 1970 to become 4.63 ton in 2010, and potato productivity increased from 11.2 ton to 24.7 ton during the same period (MAFRA, 2017). Thanks to the productivity improvement, production of the vegetables, fruits, flowers, and livestock

products has jumped up, whereas grains were produced on fewer lands, rice being the only exception due to sustained governmental subsidy measures. Technological innovations have made the Korean agriculture for more marketing, that is, from “grow to feed” to “grow to sell.” Other important technological innovations were listed at the Table 2-4.

Nutritional Situations

During the period of rapid industrialization, health status of Koreans improved substantially; infant mortality rate dropped from 64.2 in 1970 to 3.5 in 2015. Life expectancy for female also increased from 65.8 to 85.2 for the period.

〈Table 2-6〉 Infant Mortality Rate and Life Expectancy of Koreans by Period

	1970	1980	1990	2000	2010	2015	2018
Infant mortality rate	64.2	33.6	15.7	6.9	5.0	3.5	-
Life expectancy (years)							
Male	58.7	61.9	67.5	72.3	76.8	79.0	79.8
Female	65.8	70.4	75.9	79.7	83.6	85.2	85.8

Source: Lee (1988: 69); KOSIS (2018); OECD (2018).

Amount of food intake for the growth period shows gradual increase of consumption of sources of protein, i.e. meat and fish, and fruits whereas that of grain has decreased during the period of 1970 and 2016. Fruit consumption has been 10 times increased, meat 5.5 times, and fish 2 times, whereas grain consumption in 2016 has shrunken to become about 60% of its level in 1970. Meat products are, in general, high in elasticity to income level, and increased consumption of fish and fruit means diversification of food consumption and reflects heightened concern for healthy life.

〈Table 2-7〉 Per Capita Daily Intake by Food Groups

	1970	1980	1990	2001	2010	2015	2016
Grain	516.8	495.0	344.0	287.5	315.3	300.0	285.9
Vegetable	295.0	301..0	281.0	290.6	300.9	296.8	280.8
Fruit	18.9	41.3	38.8	207.2	193.1	198.3	191.2
Meat	19.8	13.6	47.3	91.4	105.0	109.6	117.5
Fish	44.5	65.7	78.6	63.6	56.3	96.3	88.0
Others	140.1	144.5	258.3	348.2	534.7	609.2	595.3
Total	1,035.1	1,061.1	1,048.0	1,288.5	1,505.3	1,610.2	1,558.7

Source: KCDC (2017); Kim et al. (2000); KOSIS (2018).

Diet habit of Koreans has transformed from the traditional food intake quickly. Per capita energy intake by type of nutrient has changed substantially for the period. In 1975, total 2,389 Kcal was daily supplied with 71.1g of protein and 27.4g of fat, which has been changed to show that total energy supply was 2,485 Kcal, 73.6g protein and 36.6g of fat in 1980. By 1995, energy consumption per capita reached 2,959 Kcal with 96.9g of protein and 76.9g of fat. The indicators mean that, during the 20 years of period between 1975 and 1995, total energy supply expanded 124%, protein 136%, and fat 281% (MAFRA, 2017: 503).

With regard to the percentage of energy intake, proportion of carbohydrate diminished from 80.5% in 1969 to 71.2% in 1986, whereas that of protein increased from 12.5% to 15.6% and that of fat from 7.2% to 13.2% (Lee, 1988: 71).

Anthropometric data reveals that the prevalence of obesity among adults in Korea in 1995 was very low: 0.8% for men and 2.2% for women. The prevalence of overweight was near 20%. The obesity level was not higher than the Philippines, Japan, Thailand, and Malaysia in the 1990s. Here, obesity is defined in terms of body mass index (BMI), in

which those who have BMI of 25.0 to 29.99 are in a body condition of overweight (pre-obesity) and BMI over 30.0 are obese. (Kim et al., 2000: 50).

RDA has long been also involved in the nutrition improvement policies and programs based on the 'applied nutrition program' or ANP (Mo, 2007: 4). The ANP started in Korea as the RDA had been established in the early 1960s by giving priority and emphasis on rural society. Around 440 extension field workers and ANP-specialized workers executed the program, under the support from international donors, such as FAO, WHO, and UNICEF, for a long period of time (1960-1986) (Mo, 2007: 4-5).

Main programs of the ANP included so-called 'ANP Model Villages' through which 1,847 villages had been selected and people got education about how to produce foods rich in nutrients. A total of sixteen rural villages—one per each province—had been chosen for implementing 'Child Nutrition Care Villages' in order to give better child growth and development through child nutrition education for pregnant women, meal service education for people and so forth, besides other income generating projects (Mo, 2007: 4-5).

Training Center for Rural Nutritional Improvement, established as an affiliated organization of RDA in December 1978, played roles of research and survey of rural nutritional status. Its responsibility also included training and education of extension workers and women. The Center was transformed in 1994 as National Rural Living Science Institute to take the roles of research on rural life in general—improvement of rural quality of life, education for rural women, research on rural culture and multiple-functions, and outlook of rural social changes (www.doopedia.co.kr, 27-11-2018).

Chapter 3

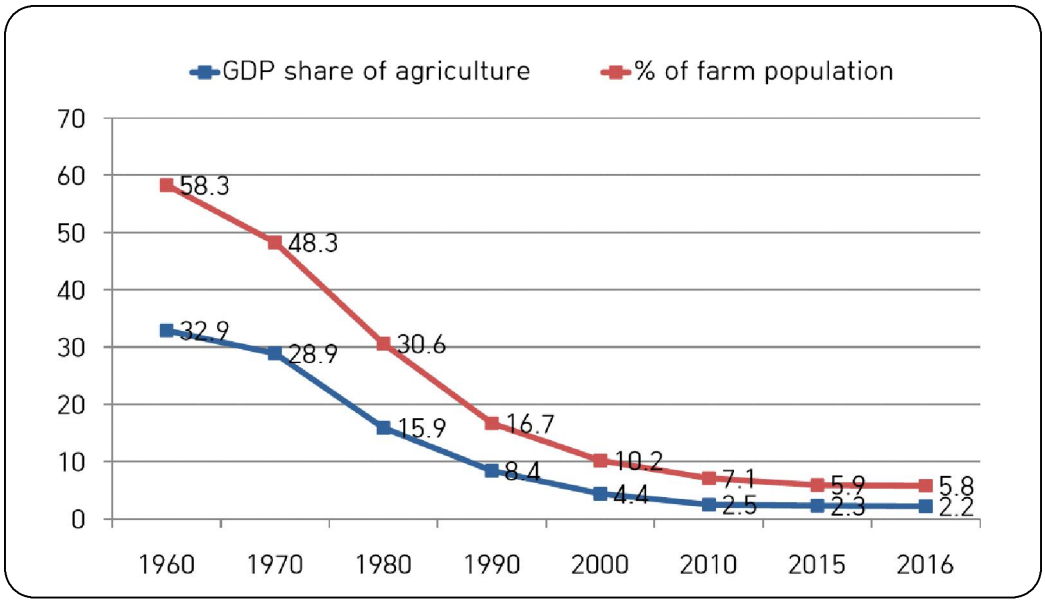
Changes of Korean Agriculture, and R&D and Extension System

1. Transformation of Food Security and Nutrition

Declined share of agricultural production in economy

Since the rapid industrialization, the rural population had sharply declined and the agriculture industry accounted for a far smaller share of the national economy. GDP share shows merely 2.2% and farm population was 5.8% in 2010, which is substantial diminishment from 32.9% and 58.3% in 1960, respectively. In 2010, the proportion of rural population over sixty years old exceeded forty percent, whereas that in 1970 was 7.1% (MAFRA, 2017). Reduced status within industrialized economy has forced the agricultural sector of Korea to turn to new areas of concerns.

〈Figure 3-1〉 GDP and Employment Share of Agriculture



Source: MAFRA (2017).

Transformation of the Korean agro-food system is required under the new economic and social conditions, globally and nationally. Decades of growth-oriented economic policies have resulted undesirable consequences like increased wealth disparity and polarization, diminished effective demands, socio-political instability, exploitation of natural resources, and so forth. Government-led centralized agricultural policies are no more efficient in leading the agro-food sector. Korea has entered into the time of retarded growth and market competition.

Kim et al. (2017) summarize key challenges faced by the Korean agricultural sector as following three points. Firstly, vicious circle of agricultural economy is sustained due to oversupply of agricultural products and low on-farm income. Secondly, 'rurality' is disappearing, and it has been caused by de-population and lack of rural vitality which has been aggravated by unsatisfactory living conditions in rural areas. Last, but not

the least, point is that solutions so far have focused upon production and productivity as well as physical improvement of rural territories, lacking in active connection with consumers and urban perspectives.

Transition of Nutritional Situations

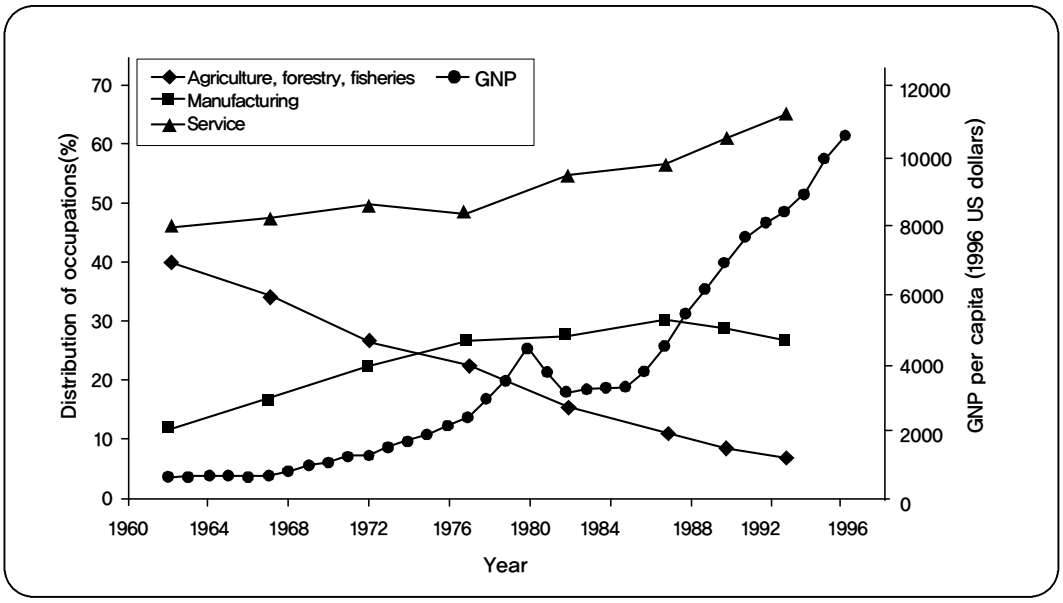
For the past several decades, since its industrialization started, nutritional status of Korean people had substantially shifted, and the transformation has been called as “nutrition transition” (Kim et al., 2000).

National Nutrition Survey Report has introduced useful information about health conditions of Korean people, although the statistics on the distribution of body mass index (BMI) was not included in the report until 1990. Obesity data were available only since 1995 (Kim et al., 2000: 45).

According to the report, the level of obesity for men has been continuously increased during the last twenty years, whereas that for women stagnated. Measuring with BMI, the proportion of people with BMI 25.0 kg/m2 or higher had been 25.1% for men and 26.2% for women in 1998. After 18 years, 42.3% of men are overweight or obese, whereas so are 26.4% of women in 2016. The special concern needs to be paid to the fact that the proportion of overweight and obese children in the age group of 6 to 18 is 15.3% for men and 11.1% for women in 2016, and it is still increasing (KCDC, 2017).

The most recent survey results show that rural people tend to be more obese than urbanites, and obesity rate of rural elementary school children is 18%, which is 3.5% point higher than urban elementary school children (NHIS, 2017).

〈Figure 3-2〉 Trends in Cause of Death in South Korea, 1938-1993



Source: Kim et al. (2000)

Trends in causes of death in Korea also show well about the transition of nutritional situations. The period before the 1960s had been represented by dietary deficit and food insecurity, and the predominant causes of death were mainly infectious and parasitic diseases. Since the early 1970s, it was changed and malignant neoplasm (e.g. cancer) and diseases of the circulatory system have been the leading causes of death.

Current nutrition issue in Korea is summarized by Jeong (2005). She argues that, unlike the past in which 'under-nutrition' had been prevalent, the condition of 'mal-nutrition' is popular in contemporary Korea due to the co-existence of 'under-nutrition' and 'over-nutrition. Although the past issue of under-nutrition had been the lack of calories, however, current under-nutrition is rather originated from the lack of specific nutrients among some deprived group of people such as underfed children, and from the nutrition imbalance (Jeong, 2005: 66).

This observation implies that even though Korea would be located at the later stages of the urbanization, economic growth, and technological changes, the pattern of nutrition intakes is not congruent with the expectation of what 'stages of nutrition transition' proposition tells. The proposition argues for the shift in patterns of nutrition intakes by development stages (H. Kim, 2018). High prevalence of under-nutrition causes stunting, wasting and under-weight, especially among children; however, as food productivity increases and famines are receding, nutrition or diet-related non-communicable diseases predominate, such as cardio-vascular problem, diabetes, cancer, etc. due to high blood pressure, over-weight and obesity, raised cholesterol, and so on.

Also, it is envisaged that many of current developing countries are facing double or even triple burdens of malnutrition among stunting, anemia and overweight. It is caused by pre-natal infant and child nutrition followed by exposure to micro-nutrient-poor, energy-dense, high-fat foods and a lack of physical activities as the child grows older (J. Kim, 2018). Citing Global Nutrition Report 2017, J. Kim (2018) maintains that, out of 140 countries, 94 countries suffer from double burden, and 29 countries triple burden, whereas 17 countries single burden.

2. Searching for New Directions

Since the rapid industrialization, the rural population had sharply declined and the agriculture industry accounted for a far smaller share of the national economy. In the 1990s, in the wake of global opening of Korean agricultural market, the agricultural sector's multiple functions were

put more emphasis also noting that the rural areas were not just the place for production activities. Particularly, as farm surpluses increased due to enhanced productivity and consumers paid more attention to healthy food and impact on the environment, the government launched a policy to promote environment-friendly farming during this period, which led to technology development in organic farming or low input agriculture (Lee, 2010: 63, 67).

Moreover, diverse policies for rural sightseeing and comprehensive rural development were adopted to help rural communities raise their non-farming incomes by utilizing the tangible and intangible resources in rural areas as tourist attractions.

Korean agriculture is now searching for new directions to adapt to the structural changes occurring in its roles and importance within economy and society. The most salient discussions are focused upon new values of agriculture or so-called 'multi-functionality,' and inclusiveness of agriculture and rural society.

Multi-functionality of agriculture

Agriculture is multifunctional, in terms that it provides not only food for people but feed, fiber, fuel and other goods. Other influences on ecosystem including water, soil, air, and so on are also from agricultural activities and cultivation. Those have important impacts also on society through offering diverse array of social activities and relations. Cultural heritages and intangible ways of life have long times transmitted through agricultural practices throughout the world. It is said that "agriculture accounts for a significant part of the livelihood of 40% of the whole population in the world and occupies approximately 40% of the total land area" (McIntyre et al., 2009: 2).

Confronting rapid industrialization which demands resource inputs and diversions from agriculture, Korean agricultural sectors have emphasized its multi-functionality with its specific context in Korean society and economy. Multiple functions of agriculture mean its contributions to the landscape formation, environmental conservation, sustainable development, and so on, in addition to the original functions of food provision for people. It is widespread understood that the social demands toward the agricultural sector are concentrated to these new values and functions.

Inclusive growth for sustainable development

Interests in environment and 'decent lifestyle' request for sustainable growth and inclusive rural transformation as well as socially responsible agriculture which supplies key public goods based on social demands.

Agricultural policies so far have been focused upon strengthening the competitiveness through structural rearrangement (Kim et al., 2017). 'To scale up farming size, and to select and concentrate' are representing what the policies have been oriented. This orientation is based on the agricultural policy paradigm putting the principle of economies-of-scale at the first and forefront. Selective resource assignment was thought to be effective in rearing up a handful of 'entrepreneurship-minded' leading farmers.

Existing policy measures are now re-evaluated and new agricultural policy strategies are on the horizon from researchers. That is, the new strategic direction should be, it is argued, toward harmonization of values among economy, society, and environmental sustainability (Kim et al., 2017), which can be summarized as 'inclusiveness'.

Inclusive growth is a newly raised policy slogan of all public agenda. International organizations, such as FAO and IFAD, have already mentioned about 'inclusive rural transformation' and its impacts on

agro-food system (FAO, 2017; IFAD, 2016). It will be a key and crucial policy direction in the agricultural sector.

New Policy Paradigm suggested

A KREI research paper published in 2017, Extension of Value and Rural Areas and the Establishment of a New Agricultural Policy Paradigm, dealt with longer-term issues (Kim et al., 2017). According to the report, a 'paradigmatic transformation' is required through policy changes. The policy directions for the new agricultural policy environment are as follows.

Firstly, it is needed to scale up the target of agricultural policy to the national level as value consumers reside in agricultural and rural areas. Secondly, the direction should be from being product (price, supply, competitiveness) -centered toward people-centered policy. The third point is to change the focus from income-centeredness to the quality of life or satisfaction of farmers and rural residents. The fourth recommendation is related to the adoption of new approaches to link the agricultural sector with 'rurality.' Lastly, agricultural sector has to acquire supports from the public through fulfilling economic, social, and environmental responsibilities.

Closely linked with these directions, KREI selected ten agricultural policy issues of Korea, which are believed to be critical in 2018, and it is worth being noted in understanding current situations of Korean agriculture and food security (B. Kim et al., 2018). What the agricultural policy should pursue are to:

1. Stipulate agricultural multi-functionality in the Constitution and expand direct payment programs for public purposes for sustainable development of agriculture and rural communities and for multifunctional agriculture;
2. Systematically set up national and regional food plans to secure basic rights to food and to build a safe food system;

3. Pursue decentralization, one of the government's major national policy directions, and reform agricultural policy governance for this;
4. Regenerate rural areas into beautiful, livable ones to maintain rurality and increase the sustainability of rural communities;
5. Revitalize rural areas and restore rural communities by expanding the rural social economy, the major policy among people-centered agricultural policies;
6. Lead agricultural innovative growth through young people's farm start-up to overcome the aging of farmers and stagnant innovation capacities;
7. Make agriculture a future growth industry by expanding the application of the 'Fourth Industrial Revolution' technologies to the agricultural sector;
8. Implement a rice production control program and reset target price to stabilize rice supply and demand;
9. Innovate the livestock rearing environment and the disease prevention system to improve agricultural production conditions and secure food safety; and
10. Strengthen responses to the expansion of protectionism and to agricultural trade issues.

3. Transformation of R&D and Extension System

Reflecting the transformations, many institutional changes had occurred to the R&D and technology dissemination system, too.

As the rural and farm population shrank, so agricultural extension

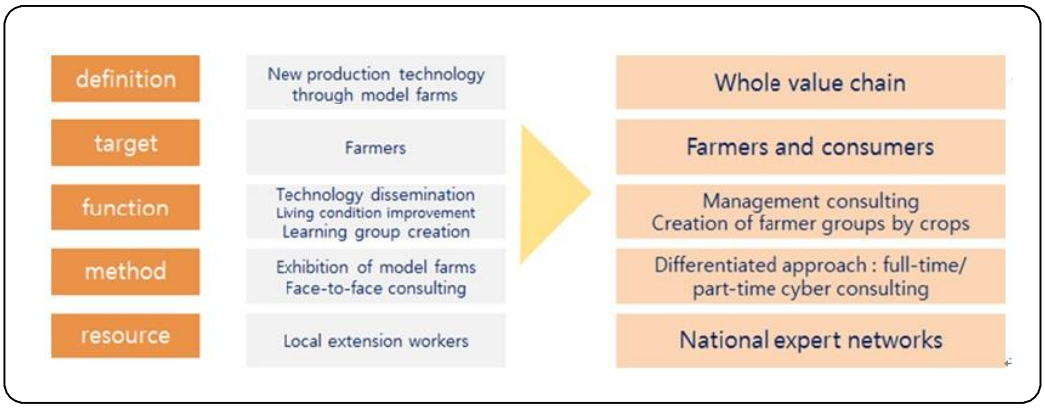
branches were led to closure or reduction in township areas from the late 1980s. Their roles were transferred to the agricultural extension offices at the city and district levels (Ko et al., 2014: 46). The township branch offices closed down and the workers were relocated to the city or district offices in 1998, which reduced the workforce to 5,000 in 1999. In the closed branch offices, consultation centers were operated by one senior extension agent (Ko et al., 2014: 46-47; Lee, 2010: 37).

Also, most of the research/extension agents who had worked for the city or district offices became the agents belonging to local governments, meaning that the functions of the agricultural extension offices as well as the appointment and management of workers, were entirely or partially under the supervision and direction of the mayors or governors. The agricultural extension office changed its name to the Agricultural Technology Center (Ko et al., 2014: 47; Lee, 2010: 38).

The focus of the agricultural technology development and extension and dissemination system changed to the extension function for rural development, instead of the agricultural technologies. Extension groups in charge of environment-friendly technologies and rural resources development were subject to the reorganization plan of the RDA headquarters and its affiliated agencies in order to support exploring new income sources in environment-friendly farming and rural sightseeing (Ko et al., 2014: 48).

Since the late 2000s the agricultural technology development and rural extension project has transformed into a public service of collecting and providing information and knowledge necessary for the entire process of agricultural sector, from developing and disseminating agricultural technologies to education and consumption (Lee, 2010: 14). The shift reflects the efforts to adapt to the aforementioned structural changes and new directions assigned to the Korean agriculture and rural sector.

〈Figure 3-3〉 Paradigmatic Shift in Agricultural R&D and Extension



Source: Ko et al. (2014: 60)

Instead of focusing upon specific production technology development, whole value chain is considered to be included in R&D and extension, therefore, including consumers besides farmers as key stakeholder and interested parties. Meanwhile, specified consulting services by crops and features of farmers are provided, trying to accommodate more inclusive advisory activities. Diverse service media utilizing cyber networks are adopted to expand the outreach programmes.

Chapter 4

Current Agricultural R&D and Extension System and Nutritional Status of Eurasian Countries

1. Agricultural R&D and Extension Services of Eurasian Countries[1]

Armenia

In the early 1990's the privatization of land and other agricultural assets brought about individual farming. However, it was found inefficient and uncompetitive due to the subsistence agriculture. In order to overcome these challenges, the Ministry of Agriculture established a new service named 'Agrogitaspyur' in cooperation with the US Department of Agriculture in 1993. During the preparation period, the new advisory agency hired 300 people to initiate the new service in 38 different regions of Armenia.

From 1997 to 1999, the advisory system faced structural changes and that created Development of Agricultural Enterprises and Small-scale

[1] This sub-chapter is a summarized excerpt from the CAC-FRAS Launching Workshop Report (August 2018), and the collaborative country assessment reports titled *Status of the Rural Advisory Service System*, edited by CACAARI in 2015. Among the countries covered by the multi-country study by the World Bank and ECFS, five are included in this part, except Russia.

Commercial Agriculture by the Government of Armenia and the World Bank and the Republican and Provincial (Oblast) Centers for Assistance to Agriculture (PCAA), which were under the Ministry of Agriculture.

The objectives of such organizations were 1) to assist farmers with new technologies of production, 2) to provide consulting services, 3) address the concerns and issues of farmers before the state bodies, 4) to develop training programs for rural and regional extension workers, and 5) to provide informative support to rural communities.

Each PCAA covers 10 regions across the nation providing 1) advisory services, 2) trainings and workshops such as field demonstration, 3) achievements of scientific research, 4) new technologies and international cooperation, and 5) market information. More than two hundred personnel are involved in such activities listed above and the number of beneficiaries was expected to be 914 communities around the country. As of 2014, the organization organized 173 pilot activities, 872 field trainings, 1,103 workshops, and 22,034 advisory activities. In addition, it provided 52 TV and radio programs on air in order to provide farming information regardless of the distance of farming areas.

〈Table 4-1〉 Number of Activities of PCAA and RCAA as of 2014

Country	Workshop	Training	Consulting	Pilot activity	Leaflets	TV & Radio
PCAA	1,103	872	22,034	173	113,110	52
RCAA	16	-	15	-	2,160	-

Source: Meruzhanovich (2015).

Republican Center for Assistance to Agriculture (RCAA) was founded according to the Decision of the Government in August 2002. The main activities of the center are 1) advisory services, 2) research and investment, and 3) media activities. The main objective of the activities is

to identify professional needs of farmers and other stakeholders in the agricultural sector. In order to meet the needs by the stakeholders, the government publishes the scientific journal, Agricultural Science, and the newspaper, Agriculture Courier. Currently, the center prepares educational TV programs on agriculture and publishes literature and materials containing scientific achievements and best practices. In collaboration with PCAA and well-known scholars in the sector, the RCAA implemented 1,103 workshops and programs on technology assessment utilizing the results of polls and survey designed and conducted by PCAA to identify the needs of the stakeholders.

As of 2012, a consultant in Armenia, on average, deals with 7 rural communities and 2,277 individual households in a month. It is expected that a consultant is able to visit an individual household 2 to 2.5 times a month and meet 30 to 40 farmers. Armenian National Agrarian University is also under the Ministry of Agriculture.

Public research organizations carry out researches on various topics such as plant protection, wine-making, vegetable and industrial crops, soil, agro-chemistry, agro-biotechnology, food security, etc.

Advisory system of agriculture is mainly public and state-operating in Armenia, but, besides those state organizations, non-state, non-governmental organizations and farm associations, unions and cooperatives, such as NGO Shen, Federation of Agricultural Associations, as well as international ones are implementing advisory services.

Currently, only 25 to 30% of 340,000 farms are using advisory services. To resolve the challenges, there came out some key governmental regulations and decisions: “On Approving Agricultural Advisory Service Program for 2013-2015” in January 2013 and “On Improving Activities of the Republican Center for Promoting Agriculture and Oblast Centers for

Promoting Agriculture in RA" in December 2013.

About 1 million USD were allocated for RAS in 2014. There remain several problems of the advisory extension services in the country. The quantitative capacity of advisory consultants is so limited. In case of Armenia, the workload of consultants exceeds the volume of work performed by consultants in other countries for 30-91 times (Meruzhanovich, 2015).

Another problem includes that the average age of the consultants is 55 years old along with the lack of young professionals in the field. It can be linked to the wage issue since the wage is too low considering to their educational level and experiences.

The government has realized the problems and decided to increase the number of consultants and provide educational trainings and qualification processes with the support of visiting foreign experts. Also, updated materials and technical supports will be provided and there will be more scientific opportunities and it will help create additional income along with their wage.

Kazakhstan

Public corporation, KazAgroInnovation, is the main executor of agricultural R&D and extension activities being responsible for the agricultural scientific research in Kazakhstan, under which there are 23 scientific research organizations (e.g. National Research Institute of Animal Husbandry and Fodder Production) and 14 experienced manufacturing farms with the support of the Ministry of Agriculture. It covers all processes of technology generation, testing, adaptation, sharing, and application (Absattar, 2015).

The aim of the extension system is to change and improve the understanding and approach to the process of production activities in the

complexes of agricultural production (CAP), through the establishment of the effective mechanisms for the best practices from the research institutions and other agro-technology users to the producers. The main services could be listed: 1) training of CAP actors for the application of the advanced technologies, 2) direct consultations through visiting farms, and 3) service maintenance.

The system of knowledge sharing is used as the main instrument of non-commercial transformation of knowledge from the research organizations to the actors of complex of agricultural production. Technology sharing is made by eleven Centers for Knowledge Sharing, which function within the framework of the corporation. Center for Knowledge Sharing can be defined as offices providing a 'feedback' to those members of CAP. The centers are aimed at applying the research developments and sharing the findings, which could be the best practices in Kazakhstan. All the advisory service activities in CAP do not require any payment from the CAP actors. The project is fully funded by the Republic of Kazakhstan. From 2009 to 2014, 15,025 CAP actors were trained and 9,889 actors had consultation services.

〈Table 4-2〉 Responsibilities of the Centers for Knowledge Sharing (CKS)

CKS Center	Responsibility
Shortandy	- SPC Grain Farm - Priority specialization: agriculture and grain farming, production, storage and process of grain products
Kostanay	- Kostanay National Research Institute of Agriculture - Priority specialization: mechanization and electrification of agriculture, resource saving technologies, and animal husbandry and veterinary
Ushkonir	- National Research Institute of Agriculture and Crop Production of Kazakhstan - Priority specialization: mechanization of agriculture, animal husbandry and veterinary, agriculture and crop production
Tassay	- South-western National Research Institute of Fishery of Kazakhstan - Priority specialization: animal husbandry, intensive agriculture and crop production, arid fodder production, etc.
Balhash	- Balhash branch of the National Research Institute of Fisheries of Kazakhstan - Priority specialization: aquaculture and fishery, feed production and grazing
Maktaaral	- National Research Institute for cotton growing of Kazakhstan - priority specialization: cotton growing, melon growing, and truck farming
Oskemen	- East Kazakhstan National Research Institute of Agriculture - Priority specialization: oilseeds, beekeeping
Kyzyljar	- West Kazakhstan National Research Institute of Animal Husbandry and Crop Production - Priority specialization: Veterinary and animal husbandry, horticulture, fodder production
Kyzylorda	- National Research Institute for Rice Growing of Kazakhstan - Priority specialization: rice growing, fodder production, truck farming and melon growing, water saving technology
Bayserke-Agro	- Private farm "Bayserke-Agro" - Priority specialization: veterinary and animal husbandry, horticulture, fodder production

Source: Absattar (2015).

〈Table 4-3〉 The Number of Activities Conducted in the System of Knowledge Sharing by KazAgroInnovation

Indicators	2009	2010	2011	2012	2013	2014	Total
Seminars conducted	79	90	90	119	105	108	591
Participation of foreign experts	-	7	15	8	12	6	48
Participants trained	1,733	2,051	2,285	3,126	2,794	2,935	45,025
Recommendations provided	15	31	59	14	72	-	191
Video clips	2	4	-	1	1	-	8
Educational films	14	15	2	1	-	-	32
Brochures	3	-	-	-	1	-	4
Direct consultation	-	258	2,287	2,421	-	4,923	9,889

Source: Absattar (2015).

Kyrgyzstan

The Ministry of Agriculture and Land Reclamation has the main responsibility of agricultural advisory services in Kazakhstan (Muminjanov, 2018). It has the responsibilities of:

- Scientific and advisory support to national agriculture;
- Development of the state scientific and technical programs and research projects at the sectoral, inter-sectoral, inter-regional, national, and international level;,
- Carrying out research activities, introduction of their outcomes in the farming practice, dekhkan (individual or family farm) and cooperative farms' activities and delivery of necessary advisory services to them; and
- Attracting investment in research activities and introduction of their outcomes into practice of advisory services.

Agricultural universities and institutes are under the Ministry of Education and Science. They include Kyrgyz State of Agrarian University, Kyrgyz Research Institute of Arable Farming, Kyrgyz Research Institute of Irrigation, and Kyrgyz Research Institute of Livestock and Pastures.

International organizations such as World Bank and IFAD has financed to support the villagers and dekhkans involved in agricultural production, providing them with applied knowledge, information, conducting training based on the specific needs of rural residents, increasing their income and reduction of poverty in rural areas. Other NGOs are also working for delivering advisory services and training.

A survey administered toward 35 rural advisory service (RAS) organizations had been implemented by Central Asia and the Caucasus Association of Agricultural Research Institutions (CACAARI); its result shows that the RAS each year provide various advisory services ranging

from 100 to 15,000 farmers in which it is located.

In Kyrgyzstan, RAS activities are financially supported mainly by donors and private contributions, and partly by the state. More than 90% of NGOs which deliver rural advisory services are dependent on donors, i.e., on external financing. Extension services lack governmental support.

Tajikistan

Mainly, there are three groups of supporting and providing rural advisory services in the country, that is, the government, private sector, and donors. The government bodies including the Ministry of Agriculture, Agency on Land Reclamation, and Academy of Agricultural Science of the Republic of Tajikistan lead RAS and support the agricultural sector (Sharipov et al., 2015).

One of the key responsibilities of the Ministry of Agriculture is the support of agricultural producers, development of recommendations on enhancing production effectiveness of different goods and performance of agricultural activities. Also, the Ministry not only monitors agricultural production and compliance of established regulations, guidelines, and standards conducting analysis of key indicators of agricultural activities, but also it delivers relevant information on agricultural production to government bodies and provincial authorities, agencies, enterprises and rural people.

Education facilities including Tajik Agriculture University are under the Ministry of Education. Its main duties in line with agricultural activities are development and implementation of government policies, regulation of education and science, improvement of research and development, and so forth. The Ministry coordinates and controls educational and scientific facilities directly through local authorities on education. It supervises 38

higher educational institutes that develop human resources in the agricultural sector such as Tajik Agriculture University, Tajik State National University, Technological University of Tajikistan, Dangarin Agriculture University, Tajik Institute of Entrepreneurship and service, and Institute of Energy of Tajikistan.

The Ministry of Labor, Migration and Employment is partly a relevant actor by providing training and testing farms of the facilities of primary professional education and training of adult people. Its main duties related to the agricultural sector is development and implementation of professional training and capacity building, organization of methodological support, and organization and implementation of monitoring system for the quality of the primary professional training and educational programs for the adults.

Major activities of agricultural research are undertaken by the Academy of Agricultural Sciences of the Republic of Tajikistan; its jobs cover developing and creating new sorts of agricultural crops and creating new breeds and types of cattle, studying and storing genetic resources, development of prevention methods and treatment of diseases of plants and animals, effective technology of their growing, scientific methods of increasing soil fertility and prevention of erosion and salinization of land, creating and improvement of agricultural techniques, conducting survey in the field of economics of agriculture, public awareness campaign and introduction of science achievements, development of highly qualified human resources for science.

The Academy's R&D institutions implement functions of agricultural test station, genetic resource center, and research institutes about agricultural economic policy, horticulture, veterinary medicine, livestock, soil science, and arable farming. Currently, there are two national centers and 6 research

and development institutions under the Academy of Agricultural Sciences.

<Table 4-4> Responsibilities of the R&D Institutions under the Academy of Agricultural Science

Institutions	Responsibilities
Pamir agricultural test station	- The main activities: cattle breeding, grain legumes, cereals, fruit growing, nursery, potato growing, horticulture, plant protection from pests and diseases
National Centre of Genetic Resources	- The main activities: grains, leguminous plants, technical plants, fodder, oilseeds, wild relatives of cereals and legumes, medicinal plants, fruit growing, viticulture, vegetable growing, melons, nurseries, potato growing, plant protection
Institute of Economy and Agriculture	- The main research: development of practical and scientific recommendations and proposal for socio-economic development in the agricultural sector and related industries
Institute of Horticulture	- The main research: horticulture, nurseries, viticulture, melons, potatoes, nurseries, plant protection from pests and diseases
Institute of Veterinary Medicine	- The main research: development of means of diagnosis, prevention and treatment of parasitic, infectious, non-infectious diseases of animals, development and improvement of technology including biological and chemotherapeutic diagnostic, drugs, and development of veterinary and sanitary measures
Institute of Livestock	- The main research: sheep and goat, dairy and beef cattle, poultry farming, beekeeping
Institute of Soil Science	- The main research: physical, biological, agrochemical, and natural properties of the soil, development of methods on improving soil fertility, protection of land against salinity and erosion
Institute of Arable Farming	- The main research: seed growing and selection of technical plants, legumes, fodder, cereals, oilseeds, and sericulture; irrigation, agrochemicals, year-round use of irrigated land, plant protection, and mechanization

Source: Sharipov et al. (2015).

The Agency on Land Reclamation and Irrigation performs a diversity of roles in the agricultural sector. The agency submits draft laws and other relevant normative legal acts to the Government and to the President of the Republic of Tajikistan. It maintains public accounting and monitoring of water resources and delivering related services to water users according to the agreements. Additionally, the agency manages drainage,

irrigation or any other water management facilities under the jurisdiction of the Agency.

Non-governmental organizations are major players in RAS field. Their responsibilities are varied from consultation to promotion and development of service cooperatives such as market information, market research, business plans. They are mostly donor-funded specialized organizations. However, their services hardly cover 10% of the sown area in Tajikistan; NGOs cannot cover all the rural areas and their services are delivered through projects in pilot areas. Besides, experts in such non-governmental RAS who are dependent mostly on the knowledge in the framework of activities funded by projects of donors often are limited to the advices that donor prefers. The risk could be high as the advices and considerations from the donors may not correspond to the situations that farmers face in real. This could lead to a negative impact on the sustainability of the services by non-governmental organizations, and deter development of commercial consulting services.

Uzbekistan

In Uzbekistan, the agricultural information and consultancy services operate in the following forms–Information and Advisory Services (IAS), Consulting Centers (CC), Private Advisory Services (PAS). IAS is implemented under Chamber of Commerce and Industry and science institutions, and by education facilities, as well as within the framework of technical assistance of international development organizations. Consulting Centers are under the Council of Farmers of Uzbekistan (Mamarasulov et al., 2015).

The Ministry of Agriculture and Water Resources works for fundamental research, applied research and innovation. Uzbek Scientific

Production Center of Agriculture is in charge of direct coordination of agricultural research at the national level, based on the decree of the President, “On improvement of activities of the Uzbek Scientific Production Center for Agriculture” promulgated in 2014.

There are 14 major public research institutes including Uzbek Research Institute of Selection, Seed and Agro-Technology of Cotton Growing. Research and Innovation Center is to ensure a widespread introduction of applied research and innovation to production. The research outputs are posted through a portal of Agro Information System managed by Information and Consultation Center (ICC) at the Tashkent State Agrarian University (TSAU), which is an example of the service providers at universities, and its main functions are informational, consulting and educational activities.

Extension services are provided approximately to 35 thousand of farmers across the country, which accounts for about 50% of farmers in Uzbekistan. Mostly, farmer’s organizations and other public organizations are the beneficiaries of such extension services,. RAS in Uzbekistan generally provides consulting services to farmers through the form of training and information activities, and the outcomes from the activities are linked to the promotion of establishing appropriate relationship between the service providers and farmers. However, the current RAS do not meet the needs of farmers in terms of level of technologies and information.

The private sector also participates in information and consultancy service provision, and a good example is an independent international NGO, Khorezm Agro-Advisory Center or KRASS which was established in 2008 for the information and consultancy service in the private sector with support of international organizations. It provides a wide range of services such as promoting sustainable and environmental development through

technology dissemination, promoting development of science and technology, promoting capacity building for young people in rural areas, and promoting development of small-scale agri-business enterprises.

However, it is judged that interrelations and coordination mechanism are still not effectively used for national agricultural research (conducted by various organizations), education and introduction. Lack of coordination would lead to a duplication of activities of various organizations. Also, educational activities by lecturers are not much related to dissemination of research and knowledge. It could result in weakening the relationship between agricultural research institutes such as universities and agricultural research system.

2. Nutritional Status of Eurasian Countries

Since the collapse of the Soviet Union, Eurasian countries have achieved the reduction in prevalence of undernourishment. Among developing countries, the average of prevalence of undernourishment in the region is quite lower than that in other regions. For instance, while the average in developing countries during 1990-1992 was 23.3 percent, that in Caucasus and Central Asia remained 14.1 percent. Recently, the average of the latter dropped to 7 percent while the former was about 13 percent. Many of countries in the region, particularly Kazakhstan, Kyrgyz Republic, Turkmenistan, and Uzbekistan, show significant reductions in prevalence rate of undernourishment; however, the rate of Tajikistan has been worse than the initiating point of the data collection.

〈Table 4-5〉 Prevalence of Undernourishment in Caucasus and Central Asia

	1990-1992	2000-2002	2010-2012	2014-2016
Caucasus and Central Asia	14.1	15.3	8.9	7.0
Armenia	27.3	23.0	6.8	5.8
Azerbaijan	23.6	17.1	〈5.0	〈5.0
Georgia	26.5	16.3	10.1	7.4
Kazakhstan	〈5.0	〈5.0	〈5.0	〈5.0
Kyrgyz Republic	15.9	16.7	7.2	6.0
Tajikistan	28.1	39.5	36.8	33.2
Turkmenistan	8.6	8.4	〈5.0	〈5.0
Uzbekistan	〈5.0	14.4	7.7	〈5.0
Developing country average	23.3	18.2	14.1	12.9

Source: FAO (2017).

Eurasian countries still have difficulty in eradicating undernourishment and poverty even though they have seen significant improvement for the past decades. Armenia, which shows more than doubled GDP in 2012 compared to 1990, significantly reduced the prevalence of the undernourished from 27.3 percent to 6.7 percent. During the same period the poverty rate declined about from 10.9 percent to 1.7 percent. Similarly, Kyrgyzstan reduced the rate of prevalence of the undernourished from 15.9 percent in 1990 to 6.2 percent. The poverty rate in the country significantly declined from 20.1 percent to 2.9 percent during the same period. Interestingly, Kyrgyzstan achieved these successful indicators without the GDP growth.

However, countries like Georgia, Tajikistan, and Uzbekistan still faced the prevalence of the undernourished and poverty. Georgia and Tajikistan did not achieve meaningful level of GDP growth unlike Armenia; particularly the GDP of Tajikistan rather declined from 3,079 US dollars in 1990 to 2,457 US dollars in 2012. During the same period, the prevalence of the undernourished increased from 28.1 percent in 1990, to 42.6 percent in 2002. The poverty remained still high in recent years even though the rate declined 35 percent in 2012. Uzbekistan, like Armenia, almost doubled

its GDP from 2,849 in 1990 to 5,008 in 2012. Its prevalence of the undernourished got worse during the period of 1999 and 2002, and, since then it was improved to record 5.5 percent in 2012. The poverty rate had been a serious concern as it used to be 71.7% in 1999 and 66.6 percent in 2002. The poverty rate still remained 27.1 percent in 2012 despite the almost doubled GDP, 5,008 US dollars.

〈Table 4-6〉 Changes of Prevalence of Undernourishment, Poverty Rate, and GDP per Capita in Selected Eurasian Countries from 1990 to 2012

	1990	1999	2002	2010	2012
Armenia					
Prevalence of undernourished (%)	27.3	21.4	19.2	6.8	6.7
Poverty (%)	10.9	16.9	15.1	2.5	1.7
GDP per capital (PPP, in 2011 int. dollars)	3,013	2,958	4,156	6,860	7,480
Georgia					
Prevalence of undernourished (%)	56.5	14.8	10.5	10.1	9.1
Poverty (%)	-	18.7	15.6	19.6	15.5
GDP per capital (PPP, in 2011 int. dollars)	5,912	3,301	4,035	6,321	6,955
Kyrgyzstan					
Prevalence of undernourished (%)	15.9	15.2	15.0	7.2	6.2
Poverty (%)	20.1	23.0	34.2	4.0	2.9
GDP per capital (PPP, in 2011 int. dollars)	3,102	2,077	2,272	2,860	3,053
Tajikistan					
Prevalence of undernourished (%)	28.1	38,8	42.6	36.8	35.0
Poverty (%)	1.1	63.0	32.9	4.3	4.7
GDP per capital (PPP, in 2011 int. dollars)	3,079	1,194	1,521	2,232	2,457
Uzbekistan					
Prevalence of undernourished (%)	〈5.0	11.5	17.7	7.7	5.5
Poverty (%)	6.6	71.7	66.6	35.6	27.1
GDP per capital (PPP, in 2011 int. dollars)	2,849	2,476	2,723	4,434	5,008

Source: FAO (2016); World Bank (2016).

A number of countries in Eurasia have shown very concerned figures in children stunting and wasting rates under five years old. Unlike the nourishment situation, the children stunting rate in Armenia rather increased from 15.1 percent in 1998 to 20.8 percent in 2010. Besides, the stunting rate, 3.3 percent, in 1998 increased 4.2 percent in 2010. It can be assumed that the GDP growth and reduction of the undernourished are not the only factors affecting the children's stunting and wasting rates. On the contrary, Kyrgyz Republic and Uzbekistan improved their stunting and wasting rates; for instance, the children's stunting rate of Uzbekistan decreased from 39.0 percent to 19.6 percent in 2006, although the figures of Kyrgyz Republic and Uzbekistan as show in the table 4-3 remain still high not unlike other neighboring countries.

〈Table 4-7〉 Indicators of Undernutrition for Eurasian Countries

		Stunting (percentage of children 〈 5 years old)		Wasting (percentage of children 〈 5 years old)	
Country	Years	First Year	Last Year	First Year	Last Year
Armenia	1998, 2010	15.1	20.8	3.3	4.2
Kazakhstan	1999, 2013	13.9	13.1	2.5	4.1
Kyrgyz Republic	1997, 2014	32.6	12.9	3.3	2.8
Tajikistan	2005, 2012	33.1	26.8	8.7	9.9
Turkmenistan	2000	28.1	-	7.1	-
Uzbekistan	1996, 2006	39.0	19.6	13.7	4.5

Source: FAO (2017).

Not only the poverty and hunger issues are concerned here, but also important micronutrients are not sufficiently provided to preschool-aged children in the region. Compared to European countries, the anemia conditions of Eurasian preschool-aged children have showed much higher

rates in both 1998 and 2010. And it has been also found that iron deficiency which causes anemia is particularly high among women—mostly pregnant women—in the Eurasian region (WHO, 2015). In other important micronutrients such as Vitamin A and Zinc are found not sufficiently provided to the children and women.

〈Table 4-8〉 Comparison of Major Micronutrient Deficiencies (%) between EU and Eurasian Countries

	Anemia in preschool-aged children*		Vitamin A deficiency in preschool-aged children**	Prevalence of zinc deficiency in total population***
	1998	2010	1995-2005	2004
European Union (EU)	15	16	-	-
Armenia	27	33	0.6	49.4
Kazakhstan	45	30	27.1	9.6
Kyrgyz Republic	44	36	26.3	13.8
Tajikistan	42	29	26.8	66.8
Turkmenistan	55	44	28.0	24.2
Uzbekistan	55	44	53.1	24.4
Russian Federation	26	26	14.1	11.7

* Estimated percent of preschool-aged (0 to 5) children with hemoglobin less than 110 grams per liter of blood. Data from FAOSTAT (2016).
** Estimated percent of preschool-aged (0 to 5) children with serum retinol less than 0.7 μmol per liter of blood. Data from WHO (2009).
*** Estimated percent of population at risk for inadequate zinc intake. The daily allowance of zinc consumption for a male of 65 kg was estimated at between 13 and 19 mg/day, depending on the type of diet (Hotz and Brown, 2004.).
Source: FAOSTAT (2016); WHO (2009); Hotz and Brown (2004).

Obesity is one of the major issues with which Eurasian countries have faced over years. The Body Mass Index (BMI) is a good indicator of obesity; if BMI is more than 30, then it is considered obese, and if BMI remains between 25 and 29, it is considered overweight. A number of Eurasian countries have shown that their prevalence of obesity increased

almost doubled for 15 years. The increase of the prevalence of obesity in Russian Federation is significant among male while the change among female increases to 9 percent during the same period.

<Table 4-9> Prevalence of Obesity* (%) among Ages 18+**, 1990-2014

	1990		2000		2010		2014		Percentage increase from 1990 to 2014	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Armenia	8.2	13.0	8.7	14.1	13.8	19.6	16.1	23.1	96%	78%
Kazakhstan	10.0	14.9	12.2	17.0	18.5	22.0	21.3	23.9	113%	60%
Kyrgyz Republic	6.1	9.3	7.0	10.7	9.8	14.7	11.4	16.7	87%	80%
Tajikistan	5.6	9.4	5.2	9.0	7.6	13.5	9.2	15.6	64%	66%
Turkmenistan	7.3	11.5	9.1	13.9	13.4	19.0	16.4	21.8	125%	90%
Uzbekistan	6.4	9.4	7.5	11.4	10.4	16.1	12.5	18.6	95%	98%
Russian Federation	10.4	24.1	12.0	23.4	17.3	25.7	19.6	26.2	88%	9%

* Body Mass Index ≥ 30kg/㎡
** Age standardized estimate
Source: WHO (2017).

Chapter 5

Challenges and Implications

1. Challenges and CACAARI's Suggestions to the Eurasian Countries

There are variations among the Eurasian countries examined above briefly; however, a few common features are identified at the risk of over-simplification: actors in R&D and advisory services, limited public resources, and limited contributions by donors.

Actors in R&D and Advisory Services

Main actors of agricultural R&D and extension systems are threefold by and large: government including public agencies, private sector either commercial or non-profit, and (mainly) international donors such as World Bank and IFAD. In many cases there are collaborations between two or three of these main actors, resulting in somewhat pluralistic extension systems (CAC-FRAS, 2018: 7).

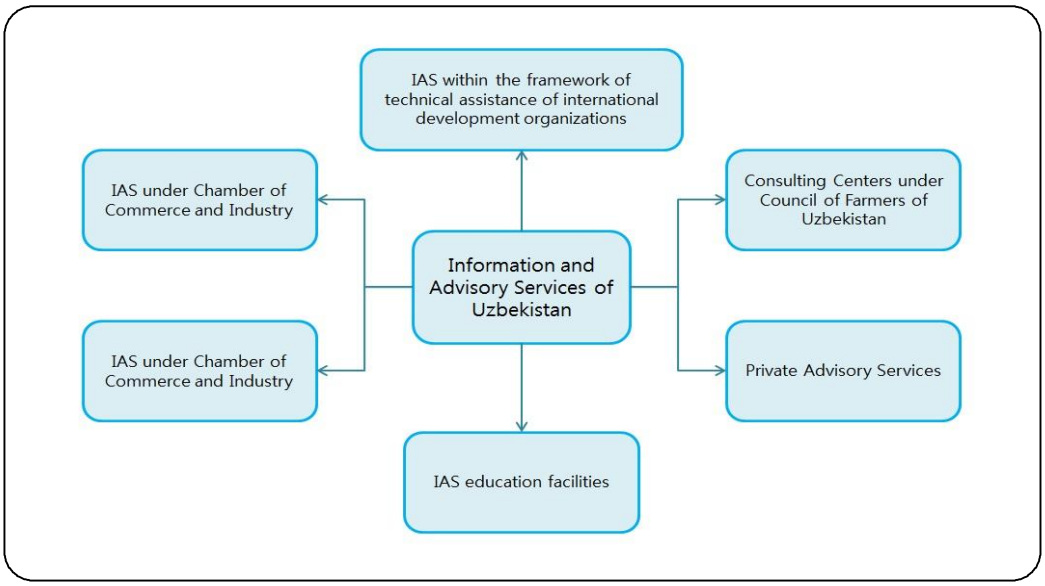
Below is a diagram showing types of activities in Uzbekistan, and the public sector (Chamber of Commerce and Industry, scientific institutions,

and education facilities), private sector (Council of Farmers and private advisory services) and donors (international development organizations) are working for advisory services for the agricultural sector.

The combination of functions of extension/knowledge sharing or counseling and scientific research needs to be closely inter-linked and coordinated by control tower organization, which would be central government authority. It is common that organizations constituting the system may have evolved separately with diverse and sometimes overlapping roles, which are not easy to clearly and properly coordinate, hampering effectiveness and efficiency.

For example, in Tajikistan, an extension organization, Sarob, sells seeds and other inputs, accompanying this with coaching. It is worried that, with a fully commercial approach to extension services, some consideration about ecological sustainability would be missed (CAC-FRAS, 2018).

〈Figure 5-1〉 Types of Activities (Uzbekistan)

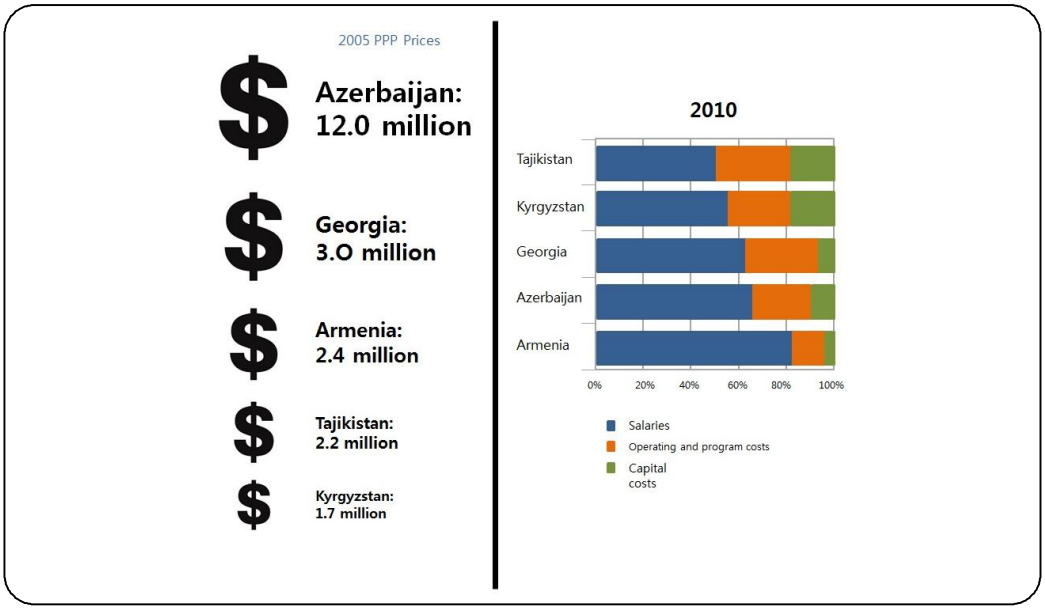


Sources: Mamarasulov et al. (2015)

Limited public resources

Significant involvement by private service providers and international organizations would mean reduced commitments by public organizations. It would further mean the lack of stable and sufficient supply of financial and human resources.

〈Figure 5-2〉 Resources for R&D and Extension Services



Source: Stads (2018).

In advanced countries, public investments in agricultural research make up 2.4% of the total agricultural GDP and in middle-income countries 0.58% (Stads, 2018). CACAARI (2015) proposes for CAC countries to invest 1% of agricultural GDP in agricultural research for development (AR4D) by 2025. However, the current level of investment in agricultural research in agricultural GDP on average among CAC countries is 0.1%, well below the target set in CACAARI, requiring substantial increase of investment. Discrepancies among countries are also significant; based on

2005 PPP prices, Azerbaijan spends 12 million USD, whereas Kyrgyzstan 1.7 million USD in 2010 (Stads, 2018).

The lack of financial resources would mean the public roles less pertinent to the technology demands of the farmers. For example, in Paraguay, the agricultural R&D organization, Instituto Paraguayo de Tecnologia Agraria (IPTA), is supported only about three quarters of its annual budget from the state, thereby earning the rest by developing and selling technologies for private agricultural enterprises rather than small farmers (Bae et al., 2014).

Government authorities may not be able to initiate policy programs with specific purposes with regard to agricultural technology development and dissemination as intended, reducing the state's role as the control tower of agricultural and rural extension services.

As seen from the figure above, human resources are not sufficient in the countries. Researchers, working full-time or equivalent, are 391 in Armenia and 161 in Kyrgyzstan (Stads, 2018). As discussed above, the farmers benefitted by extension and advisory services are limited due to insufficient quantity of workers. The number of advisory consultants is so limited and the workers suffer from the overload of consultancy in Armenia. Their advisory services hardly cover 10% of the sown area in Tajikistan. Private organizations can only cover project areas. About a half of farmers get benefits of training and information sharing from extension services in Uzbekistan.

Limited contributions by donors

Donor contributions have been critical in the countries of the region; however, the efforts may have been fragmented and need to be cautiously coordinated based on program approach.

Donors will define activities and services in advance, based on project strategy rather than fully taking into account the interests and desires of customers. And their services are not sustainable; they are increasing or decreasing depending on the availability of funds.

In case when the NGOs are the agents, there is a risk that the real needs of farmers are not realized due to the fact that the NGO's services are limited with donors' preference advices.

Another problem is that the donor funding tends to be fragmented and confined to a certain range, hard to cover a full production and sale cycle.

CACAARI's Suggestions

Central Asia and Caucasus Association of Agricultural Research Institutions (CACAARI) is a non-profit international forum, which has mission to "serve as a neutral forum, where various stakeholders of agricultural research for development in Central Asia and the Caucasus can discuss and debate on issues critical to the agriculture of the future".

The CACAARI members, from regional to global stakeholders, from global to regional stakeholders and among various stakeholders in the region, are communicating to contribute actively to knowledge sharing processes and capacity building exercises (cf. CACAARI website, www.cacaari.org/en.php, accessed 28-09-2018).

CACAARI's recent strategic document for this region, Regional Strategy for Transforming and Strengthening of Agricultural Research and Innovation Systems for Development in the Central Asia and Southern Caucasus region, set components which need to be achieved by CAC countries. They are:

- Setting up main priorities and measures of AR4D at national, regional and global levels;

- Ensuring equal opportunities for participation and transparency among all stakeholders;
- Increasing investments in agricultural research and innovation;
- Strengthening human and institutional capacity;
- Integrating innovation into national and regional development programs and policies;
- Systematic monitoring, evaluation and reporting of measures; and
- Increasing the impacts of ICT.

2. Implications from Experiences of Korea

More ofthen than not, past development experiences of other countries prove to be excellent examples and references for both policy makers and experts. During the rapid economic growth and social development for the past four or five decades, Korea has envisaged many positive accomplishments in agricultural technology R&D and extension.

Although there are many levels of differences between target countries and Korea, what have been done in Korea for the development periods will provide some 'food for thought' in finding out social, economic, political, and institutional constraints, and introducing new strategies of transformation. With regards to the R&D and extension of agricultural technology for farmers and nutrition for the population, Korean RDA and its affiliated organizations have contributed to the productivity enhancement and nutritional improvement along with industrialization and urbanization for the past decades. The importance of agricultural technology development and its application on the farms for agricultural development

cannot be overemphasized. Below are three key lessons to learn from Korean experiences and implications.

Efficiency in Coordinating Functions of R&D and Technology Dissemination

Usually, governmental agencies are to diverse degrees taking care of R&D and rural extension. As explained above, in Korea, both functions have been performed by one governmental organization, which is RDA.

Whether both R&D and extension functions are performed by a single organization or not is decided by historical backgrounds. It is crucial that the capabilities of agencies responsible for R&D and extension service must be diagnosed, and the governance must be strengthened. It includes the specification of the roles of research institutes developing the technologies, and the extension service actors to be organically connected and cooperate.

When the two functions are performed by separate organizations, an efficient coordination between them is important. Efficient coordination would include manpower restructuration and reorganization of functions.

In Paraguay, the agricultural R&D and extension services are not coordinated efficiently. DEAg (Dirección de Extensión Agraria) is in charge of rural extension, whereas IPTA (Instituto Paraguayo de Tecnologia Agraria), a public agricultural research institute, is for R&D. Although they both belong to the same Ministry of Agriculture and Livestock, their roles are overlapped. In local areas, IPTA has research centers and demonstration farms in department level, and DEAg operates technology support offices in a smaller administrative unit. Technology transfer to local areas and getting feedbacks from farmers, and local technicians and extension workers may not be effective (Bae et al., 2014).

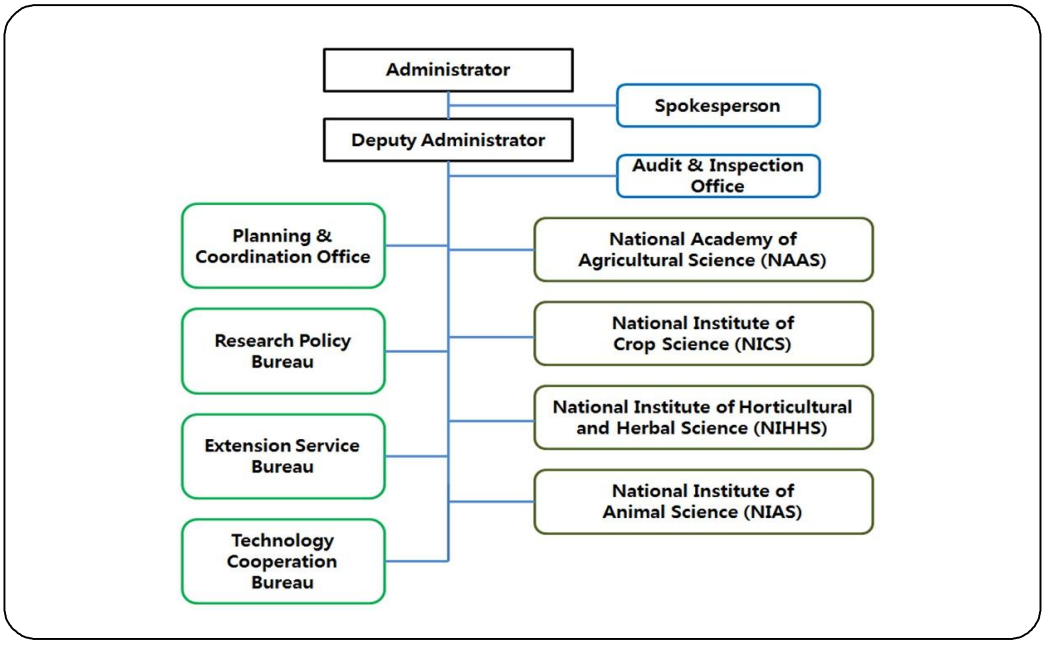
Korea decided that both functions belonged to the same central government and the extension functions were monopolized by its local

branches by law in order to exclude the possibility of confusion on the fields.

RDA has four national research institutes: National Institute of Agricultural Sciences, National Institute of Crop Science, National Institute of Horticultural and Herbal Science, and National Institute of Animal Science. They have labs and experimental farms for research and demonstration for farmers in local areas. Besides, four bureaus are under the Administrator, which are for Planning and Coordination, Research Policy, Extension Service, and Technology Cooperation.

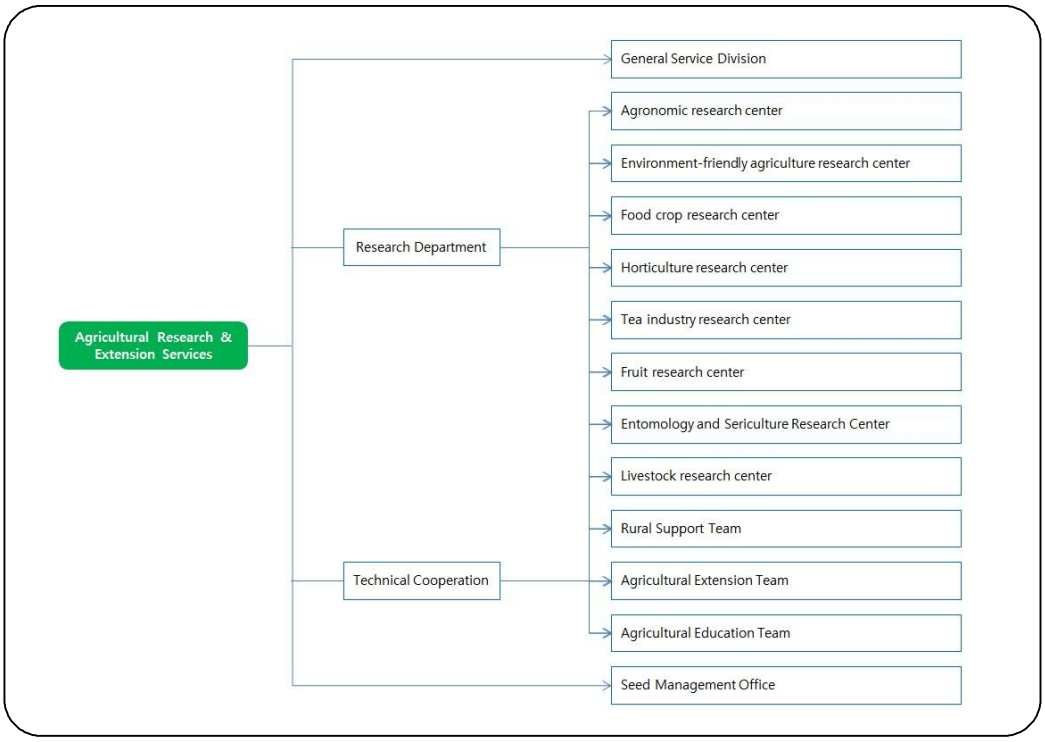
The agricultural extension system is constituted of nine Provincial RDA, Provincial Agricultural Research and Extension Services under the central RDA; and 158 City/District Agricultural Technology Centers and around 700 Township Counseling Offices, which are now supervised by the local governments (www.rda.go.kr, 28-09-2018).

〈Figure 5-3〉 Organization of RDA of Korea



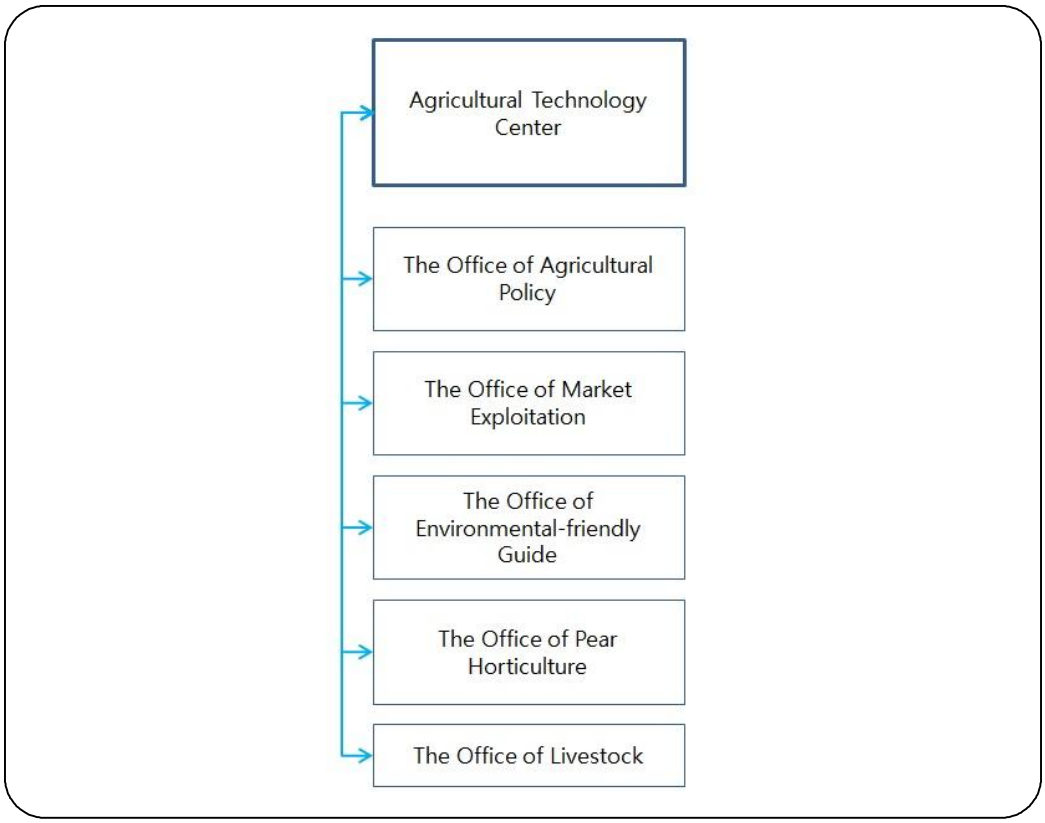
Source: www.rda.go.kr (29-11-2018).

〈Figure 5-4〉 Organization of Provincial R&D and Extension Services of Jeollanam-do



Source: http://www.jares.go.kr (27-11-2018).

〈Figure 5-5〉 Organization of Extension Services of Naju-si



Source: http://www.naju.go.kr (27-11-2018).

Extended Involvement by Public Sector

Taking features of agriculture into account, budget support is required to be expanded to vitalize the agricultural sector and enable mid- and long-term research to be carried out in a stable manner.

The countries specified above run central government-affiliated local organizations for R&D and extension services. Nevertheless, substantial parts of rural advisory services depend on donor-funded and NGO-operating projects. Governmental budget for research is not sufficient, too; current level of investment in agricultural research on average among CAC countries is 0.1% in agricultural GDP.

Basically all agricultural R&D and extension organizations have been publicly financed in Korea, meaning less reliance on private investment or supports. It has made it possible to spend money on personnel and equipment for mid- and long-term basic research.

Korea's RDA is not a sub-ordinate agency of the Ministry of Agriculture, Food and Rural Affairs (MAFRA). The RDA is a lower-level organization than the MAFRA, but it is one of central governmental administrative bodies subject to separate budget planning, whose budget is totally supplied by the state. R&D in the agricultural sector requires mid- and long-term basic research, which in turn leads to the need for a stable inflow of budget and support.

Total budget for 2018 is about 844 million USD, and, excluding fixed costs such as personnel expenses, working expenses are about 689 million USD. The share of budget for R&D of the expenses is 66% and technology dissemination takes 29% (www.rda.go.kr, 28-09-2018).

As of 2014, there are 1,856 personnel working in of RDA, including 1,165 scientists and 95 extension specialists. Provincial RDA has in total 641 scientists and 237 extension specialists, and city/county and township centers and offices have 4,151 extension workers (Yoo, 2018).

Extensive Involvement other than Traditional Functions of Technology Dissemination

Korean extension services had extended to cover the tasks of rural development, including improvement of living conditions and nutrition as well. This kind of comprehensive extension and dissemination system would be required, especially in underdeveloped regions. It is more effective for extension service workers to work for comprehensive services including dissemination of agricultural technologies and whatever related with meeting

basic needs and improvement of social conditions for underdeveloped regions, such as hygiene, organization, and rural development planning as well as education on nutrition and diet.

Since its inception, RDA had been in charge of community development as well as promoting rural organizations such as 4H clubs. In 1978, Training Center for Rural Nutritional Improvement started to capture and coordinate many nutritional improvement programs. As of now, Korea is not intervening farmer groups' autonomous activities, nor putting policy priority on the improvement of nutritional deficiency, although nutritional imbalance is more frequently on the public agenda.

Recent RDA efforts cover the creation of new income sources in rural areas. For example, so-called "Green Tourism" programs are for attracting urban visitors, through developing diverse rural tourism resources. Other projects include leisure activities for the old farmers, and information and consulting services for those "urban to rural returners" who are interested in settling down in rural areas (Yoo, 2018).

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