OECD Food and Agricultural Reviews

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Foreword

Innovation, Agricultural Productivity and Sustainability in Korea is a part of the OECD Food and Agricultural Reviews series. The review was implemented as a co-operative activity with the Korea Rural Economic Institute (KREI) under the leadership of Chang-Gil Kim. It examines the conditions in which farms and businesses in Korea undertake innovation in the food and agriculture sector to become more productive and environmentally sustainable. It starts with an overview of the food and agriculture sector and outlines development challenges and opportunities (Chapter 2). A wide range of policies which influence incentives for innovation are then examined: a favourable and predictable environment for investment (Chapter 3); capacities and public services enabling business development (Chapter 4); agricultural policy (Chapter 5) and the operation of the agricultural innovation system (Chapter 6).

Policies in Korea are analysed following a framework developed by the OECD as part of its work on agricultural innovation and in response to a request from the G20 in 2012 under the Presidency of Mexico to evaluate the extent to which a wide range of policies facilitates productivity growth and sustainability in food and agriculture. The framework has been applied to Australia, Brazil, Canada, the People's Republic of China (hereafter "China"), Estonia, the Netherlands, Sweden, Turkey, and the United States, and additional reviews are underway or planned.

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The inputs to this review also included background report by Myoungki Lee and Jeonghoi Heo of KREI on agricultural innovation system. Jae-hoon Sung of KREI also privided the analysis of farm size distribution and productivity measurement. The inputs to this review also included the consultant reports: on the competitiveness of the food industry by Byeong-il Ahn and Mi-Ra Choi of Korea University; on macroeconomic and land policy by Jeong-Bin Im of Seoul National University; on education policy by Jinchul Jeong of Seoul National University; on labour policy by Kyu-yong Lee of the Korea Labour Institute; on tax and social security policy by Myungheon Lee of Incheon National University; on trade and investment policy by Song-Soo Lim of Korea University; on financial market policy by Sang-Taek Seo of Chungbuk National University; and on environmental performance of agriculture, environmental regulation, water policy and agri-environmental policy by Oh Sang Kwon of Seoul National University. The review also draws on OECD analyses in other economic and social policy fields, and uses cross-country comparable indicators developed by the OECD and other international institutions, such as the World Bank and the World Economic Forum.

This report has benefitted from comments from Il-Jeong Jeong, Kyungmee Kim, Namgeun Song and Wonsup Yoon (MAFRA), Hyunchul Jeong (APQA) and Minchul Kang (Permanent Delegation of Korea). It has also received valuable comments from Carmel Cahill, Frank Van Tongeren, Catherine Moreddu, Emily Gray and Jose Enrique Garcilazo (OECD). In-Ae Yi and Seung-Min Park (MAFRA), Jeonghoi Heo, Hanpil Moon and Sungmin Cheu (KREI), Woo Seok Jeon (EPIS) and Marina Giacalone-Belkadi (OECD) provided valuable support in implementing the project.

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Table of contents

Tables

Figures

Boxes

Acronyms

AFACI	Asian Food and Agriculture Co-operation Initiative
AI	Artificial Intelligence
AIS	Agricultural innovation system
APQA	Animal and Plant Quarantine Agency
APR	Agriculture Promotion Region
ASEAN	Association of Southeast Asian Nations
ASG	Agricultural Safeguard
AT	Korea Agro-Fisheries and Food Trade Corporation
BAU	Business-As-Usual
BERD	Business Expenditures on R&D
BOD	Biochemical Oxygen Demand
BTL	Build-Transfer-Lease
BTO	Build-Transfer-Operate
COD	Chemical Oxygen Demand
CSE	Consumer Support Estimate
CRCs	Co-operative Research Centres
EIA	Environmental Impact Assessment
EPIS	Korea Agency of Education, Promotion and Information Service in Food, Agriculture, Forestry and Fisheries
EPS	Employment Permit System
ETS	Emission Trading Scheme
EU	European Union
EU15	15 member states of the European Union, which were members in 2003
FACT	Foundation of Agricultural Technology Commercialization and Transfer
FDI	Foreign Direct Investment
FMD	Food-and-Mouth Disease
FPP	Farmland Purchase Program
FSS	Financial Supervisory Service
FTA	Free Trade Agreement
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GHG	Greenhouse gas
GIS	Geographic Information System
GNI	Gross National Income
GSSE	General Services Support Estimate
HPAI	Highly Pathogenic Avian Influenza
ICT	Information and Communications Technology
IPCC	Intergovernmental Panel on Climate Change
IPET	Korea Institute of Planning & Evaluation for Technology in Food, Agriculture, Forestry and Fisheries
IPR	Intellectual Property Rights
KCDC	Korea Centres for Disease Control & Prevention
KDC	Korean Dairy Committee
KECO	Korea Environment Corporate
KFS	Korea Forest Service
KFTC	Korea Fair Trade Commission
KISTEP	Korea Institute of Science & Technology Evaluation and Planning
KOPIA	Korea Project on International Agricultural
KOSTAT	Statistics Korea
KRC	Korea Rural Community Corporation
KREI	Korea Rural Economic Institute
KRW	South Korean Won
LMO	Living Modified Organism
MAFRA	Ministry of Agriculture, Food and Rural Affairs

ME	Ministry of Environment
MFDS	Ministry of Food and Drug Safety
MFN	Most Favored Nation
MOF	Ministry of Oceans and Fisheries
MoHW	Ministry of Health and Welfare
MOIS	Ministry of Interior and Security
MOLIT	Ministry of Land, Infrastructure, and Transport
MOSF	Ministry of Strategy and Finance
MOTIE	Ministry of Trade, Industry, and Energy
MPS	Market Price Support
MSIT	Ministry of Science and ICT
MSS	Ministry of SMEs and Startups
N	Nitrogen
NACF	National Agricultural Co-operative Federation
NAQS	National Agricultural Products Quality Management Service
NBLG	National Basic Livelihood Guarantee
NH	NongHyup
NHI	National Health Insurance
Nongshinbo	Agriculture, Forestry and Fisheries Credit Guarantee Fund
NP	National Pension
NRF	National Research Foundation of Korea
NSTC	National Science and Technology Council
NTIS	National Science & Technology Information Service
OECD	Organisation for Economic Co-operation and Development
P	Phosphorous
PACST	Presidential Advisory Council on Science & Technology
PPP	Polluter Pays Principle
PPPs	Public and Private Partnerships
PSE	Producer Support Estimate
R&D	Research and Development
RDA	Rural Development Administration
RPC	Rice Processing Complex
SARD	Special Account For Regional Development
SME	Small and Medium Sized Enterprises
SOC	Social Overhead Capital
STCA	Science and Technology Commission of Food, Agriculture, and Forestry
STRD	Special Tax for Rural Development
TFP	Total factor productivity
TMDL	Total Maximum Daily Load
TRQ	Tariff Rate Quotas
UN	United Nations
UNI-PASS	Korea Customs e-Clearing System
VAT	Value Added Tax
VOC	Volatile Organic Compounds
WEF	World Economic Forum
WTO	World Trade Organisation

Executive summary

Korea has achieved the fastest growing income per capita amongst the OECD economies over the past 25 years. During that time, the share of primary agriculture in the economy has declined as its export-driven economy has reallocated capital and human resources to manufacturing. The food and agriculture sector has been under pressure to meet changing domestic demand, to improve its productivity to keep up with the highly competitive manufacturing sector and to increase its exposure to international competition under the GATT Uruguay Round Agreement on Agriculture and bilateral Free Trade Agreements (FTAs). The societal demand on agriculture has diversified from focussing on stable supply of food to other functions of agriculture, such as preservation of natural resource and ecosystem as well as traditional culture and rural landscape.

The agro-food sector in Korea faces a number of challenges today. Per capita arable land area (0.03 ha) is the smallest among OECD countries. The highly fragmented land ownership structure hinders consolidated use of cropland and limits the scale of operations. Korea does not have a comparative advantage in land intensive crop production. By contrast, the livestock sector has expanded rapidly to meet a growing national demand and now accounts for nearly a half of the total value of Korea's agricultural production. However, the rapid expansion of intensive livestock production has aggravated the environmental pressure from manure emissions.

The government has made extensive efforts to support agriculture through a wide range of policy measures. In addition to market price support and direct payments to support farm incomes, the sector benefits from preferential tax treatment, reduced social security contributions and reduced input prices. Nevertheless, income problems persist among small-scale and aged farmers, who have limited employment opportunities outside the sector. Sector-specific agricultural policies have limited capacity to solve the low-income problem. Policies covering economy-wide rural development and social security should play a more proactive role in addressing low-income issues among rural households. Meanwhile, younger people in rural areas would benefit from employment opportunities arising from a more comprehensive rural development policy.

Despite its comparative disadvantage in land-intensive crop production, Korea's potential to export niche agricultural products and processed food that reflect its rich and unique food culture could be explored further. Focusing agricultural policy more on improving the productivity and sustainability of commercial producers and developing the food processing sector is critical to establishing a more competitive and sustainable food and agricultural sector, as is increasing the capacity to respond to market demand. Facilitating fair competition in input and output markets is an important policy agenda to meet the specific needs of large commercial producers.

Investment in agricultural innovation is fundamental to ensuring the long-term competitiveness and sustainability of agriculture, and Korea is one of the most intensive investors in public agricultural R&D among OECD countries. To unleash the sector's potential to be more knowledge-intensive, Korea's agricultural innovation system should

become more integrated and collaborative, benefiting from a strong advantage in information and communication technology (ICT) and responding efficiently to the needs of commercial farmers and agro-food firms. Policies should also promote knowledge flows, thereby facilitating the adoption of innovations in technology, production, management and marketing practices. Furthermore, to meet the particular needs of commercial producers to improve productivity and sustainability, the extension system should evolve to leave more room for private technical service providers in transferring technologies, capital and information.

Main findings and key policy recommendations are outlined in the table below.

Main findings	Key recommendations
Developing the economic and institutional environment for fair and open competition	
Agricultural co-operatives have high market shares in certain input and output markets	Ensure fair competition between agricultural co-operatives and other private agricultural service and input suppliers under the existing provisions of the Monopoly Regulation and Fair Trade Act.
The fuel tax exemption and reduced charges on agricultural inputs may create incentives for excessive use of inputs and natural resources.	Review Value Added Tax (VAT) exemptions on certain agricultural inputs and the fuel tax exemption to promote more sustainable agriculture.
Ensuring efficient and sustainable use of agricultural resources	
Subdivision of farmland ownership through inheritance is exacerbating land fragmentation.	Reform the property tax system to provide incentives for the succession of farms to a designated successor.
The high price of farmland, reflecting the potential non-agricultural use value of land, is discouraging farm consolidation and encouraging land abandonment.	Apply stricter land conversion regulation to farmland within designated Agricultural Promotion Regions (APR), while concentrating policy support to guide land conversion outside them.
Informal land lease is reducing the incentive to invest in land improvement and rent out land to more efficient users.	Revise the farmland regulations to promote tenant farming and penalise undocumented land rental transactions.
Free supply of irrigation water reduces the incentive to conserve water use.	Ensure that charges for water supplied to agriculture at least reflect full supply costs.
Professional education for agriculture is attracting less attention.	Reorient the agricultural education system to focus on skills required in the agricultural sector, and not only on formal qualifications.
Developing a coherent agricultural policy more conducive to long-term productivity growth and sustainability	
Overall portfolio of agricultural policy is dominated by policies that are linked to production of staples and to supporting farm income.	Continue rebalancing the portfolio of agricultural support to public investment oriented towards long-term productivity growth and sustainability.
Commodity-specific support constrains farmers' responses to market signals, hinders structural adjustment toward production of more value-added products and increases environmental pressure from agriculture.	Phase out border protection and commodity-specific support to allow markets to play their role in allocating production resources to more high-value-added niche products
A more comprehensive policy approach beyond agricultural policy is needed to address the low-income problem of farm households.	Increase the role of the general social security system as an income safety net for farm households by introducing adjusted eligibility criteria and additional incentives for early retirement and resource transfer to young commercial farmers. Take a more bottom-up approach to promoting integrated investments and public services that are geared to local needs to attract non-agriculture industries to locate in rural areas.
Exemption of income tax could impede resource reallocation to more profitable and competitive non-grain agricultural sectors and reduce farmers' incentive to record and manage their farming business activities through bookkeeping.	Consider taking steps to induce farmers to declare income situation to facilitate the self-evaluation of the financial performance of the farm and to allow the government to design better-targeted policies to the household income.

Main findings	Key recommendations
There is no clear definition of reference environmental quality with which farmers need to comply.	Establish a framework of agri-environmental policies that clarifies the reference environmental quality as well as environmental targets.
The growing issue of livestock manure emission requires a more comprehensive policy approach, beyond regulation alone.	Take a multi-dimensional approach to manure management, including regulation, incentives to invest in new technology, capacity-building of producers and building partnerships between stakeholders.
Establishing a more collaborative agricultural innovation system among public and private actors	
The public sector dominates investment in agricultural R&D.	To let private R&D investment play a greater role, concentrate public R&D investment in areas of public interest, such as environment and resource conservation, and on areas where the private sector would naturally under-invest.
Public R&D projects are implemented largely by a top-down approach and can reflect more the technical demands of commercial farmers.	Allow the participation of a wide range of stakeholders in the public R&D planning and evaluation process to reflect their technical needs. Increase the participation of farmers in R&D projects of public R&D institutions and universities.
A weak network exists between different actors in the agricultural innovation system, including weak public and private partnership in agriculture R&D projects.	Enhance collaboration between different actors in the agricultural innovation system, for example by increasing conditionality of public agriculture R&D projects on collaboration with private sectors, higher education institutions and other public R&D institutions.
Inadequate co-ordination exists between different government agencies engaging in public agricultural R&D.	Strengthen the co-ordinating function of the Science and Technology Commission of Food, Agriculture, and Forestry to form a more consolidated and coherent public agricultural R&D investment strategy.
The public extension system's standardised services are limited to meeting producers' needs, and the development of private technical advisory services is limited.	Redefine the role of the public extension system, leaving more room for private technical service providers in transferring technologies, capital and information. Shift the focus of the public extension service to the provision of public goods such as improvement of environment performance, and to the governance of the whole system to ensure access of small farmers to relevant advice.

Chapter 1. Assessment and recommendations

This chapter presents the framework used in the report to analyse the extent to which policies in Korea are supportive of innovation and structural change, and the extent to which they affect access to, and use of, natural resources for productivity growth and sustainability. It also gives an overview of the review's findings on a wide range of policies and develops specific recommendations for related policy areas.

1.1. A framework for analysing policies for innovation, productivity and sustainability in the food and agriculture sector

Improvements in agriculture productivity growth are required to meet the growing demand for food, feed, fuel and fibre, and must be achieved sustainably through a more efficient use of natural and human resources and a reduction of pollution. A wide range of economy-wide policies affect the performance of the food and agriculture sector, and thus need to be considered alongside agriculture-specific policies. Recognising that innovation[1] is essential to improving productivity growth sustainably along the whole agri-food chain, this report dedicates specific attention to the performance of agricultural innovation systems.

The policy review framework used in this report considers policy incentives and disincentives to the key drivers of sustainable productivity growth: innovation, structural change, and the environmental sustainability of agriculture (Figure 1.1).

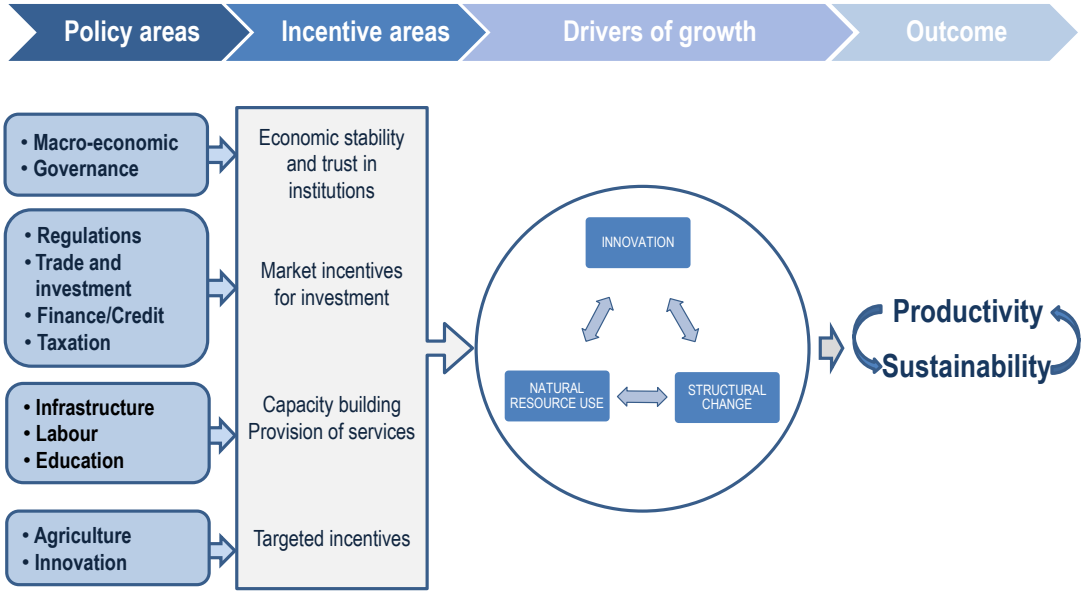
This review begins with an overview of the characteristics and performance of the food and agriculture sector and the challenges it will face in the future (Chapter 2). A wide range of policies is then considered according to the main channels or incentive areas through which those policies affect drivers of productivity growth and sustainable use of resources.

- The economic and institutional environment, both of which are essential to attract long-term investment (Chapter 3).
- Capacity building, including provision of essential public services (Chapter 4).
- Agricultural policy, domestic and trade related (Chapter 5).
- The agricultural innovation system (Chapter 6).

This review draws on background information provided by the Korea Rural Economic Institute (KREI) and other experts, and on recent OECD agricultural, economic, rural, environmental and innovation policy reviews.

Throughout the report, the likely impacts of each policy area on innovation, productivity growth and sustainability are discussed, and recommendations are drawn on a large range of policy areas.

Figure 1.1. Policy drivers of innovation, productivity and sustainability in the food and agriculture sector



Source: OECD (2015).

1.2. Policy challenges for innovation, agricultural productivity growth and sustainability in Korea

Remarkable economic growth in Korea in the last four decades has been led by export-oriented industrialisation. In this process, the share of agriculture in value-added, employment and trade has diminished rapidly. The sector has been under pressure to meet changing domestic demand and to improve its productivity to offer farm households equivalent income to urban ones in a very limited time. At the same time, the policy environment has changed to increase the exposure of domestic producers to international competition; the GATT Uruguay Round Agreement on agriculture and various bilateral FTA agreements have been amongst the driving forces behind market opening. The societal demand on agriculture has diversified from focussing on stable supply of food to other functions of agriculture such as preservation of natural resource and ecosystem as well as traditional culture and rural landscape.

Korea also achieved higher productivity growth in primary agriculture than the OECD average for the last five decades, driven mainly by a declining labour input through rural to urban migration and farm mechanisation. Resource reallocation to more productive farms and commodity sectors has been the main driver of productivity growth, which has improved at the sector level but has been rather limited at the farm level.

Korea is one of the most land-scarce countries of the OECD. Per capita arable land (0.03 ha) is the smallest among OECD countries, giving the land-intensive crop sector a comparative disadvantage. Moreover, a fragmented land structure makes consolidation of cropland use particularly challenging. The concentration of land to large-scale farms has been slow. While more than 65% of Korean farms are less than 1 ha in size, the share of land cultivated by farms with more than 10 ha of land was only 14% in 2015.

Changes in the structure of the Korean agricultural sector were driven by a rapid change in the pattern of food demand. The "westernisation" of the Korean diet associated with income growth reduced per capita rice consumption and increased the demand for livestock products. While the value share of rice in agricultural production declined from 37% to 17% between 1970 and 2015, the share of livestock products increased from 15% to 43% during the same period. The operational size of livestock production units expanded rapidly to be comparable with EU member states.

Despite the declining share of primary agriculture in the economy, controlling environmental impacts of agriculture on natural resources remains important: the sector occupies 20% of total land area and accounts for almost half of total water withdrawal. Korea has reduced the use of chemical fertilisers and pesticides, but the rapid expansion of intensive livestock production has made manure emissions the main agricultural source of water and soil pollution. The growing share of greenhouse farming has increased energy use in food production; the nitrogen (N) and phosphorus (P) surplus per ha in Korea remains one of the highest among OECD countries. Contamination and pollution of soil and water resources raises uncertainty about future productivity growth, as do climate change (which is expected to raise temperatures), the spread of pests and disease, and more frequent and more severe droughts and floods. Promoting sustainable use of land and water and increasing preparedness to climate change is an important policy agenda to assure long-term growth in agriculture.

Rapid industrialisation in urban areas and the migration of the young population from rural to urban areas have led to rural areas being economically left behind, resulting in higher income gap between farms and urban households. The level of the average farm household income declined to 65% of the average urban household income – one of the largest income gaps observed among OECD countries. Real farm income has been declining since the late 2000s as the growth in farm expenditure exceeds that of farm receipts. Increased off-farm income has been contributing positively to the incomes of farm households, but off-farm employment opportunities are limited in rural areas.

The farm structure in Korea will be further polarised between more productive large-scale commercial producers and less productive small-scale producers. For example, in the rice sector, farm-level productivity measurement shows that productivity growth is led by a small number of large commercial producers. Efforts to facilitate structural change in agriculture should continue, but agricultural policy should focus more on enabling commercially viable producers to improve productivity and sustainability performance at the farm level. Meanwhile, policy makers should recognise that sector-specific agricultural policies have a limited capacity to solve the low-income problem of small-scale producers. Policies covering economy-wide rural development and social security should play a more proactive role in addressing low income issues among rural households.

Future demographic change and slowdown of economic growth will have a significant influence on Korean agriculture from both supply and demand sides. Currently, 59% of farmers are over 65 years old, but the average age of farmers is expected to increase further. The domestic food market is unlikely to expand due to the declining and ageing population. Per capita consumption of rice nearly halved in just 25 years, and is likely to decline even further.

Given the limited demand growth in Korea's domestic food markets, opportunity for future growth of its agriculture is increasingly dependent on access to export markets for high-value-added agro-food products. Here, Korea has the potential to develop its food and agricultural sector, including by producing high-value niche products for both the matured

domestic market and growing markets in Asia. To assure the long-term health of Korea's food and agriculture system, it is critical to increase its capacity to respond to market demands.

Despite declining domestic demand, Korea's relatively small food manufacturing industry is growing rapidly. Its share in the overall manufacturing sector is much smaller than in other OECD countries and, dominated by small-scale firms, its labour productivity lags that of its competitors. Promoting the industry will be a particularly important policy area if the opportunities to produce value-added food products are to be exploited. The industry also has the potential to create employment in rural areas.

1.3. Developing an economic and institutional environment for fair and open competition

Korea has one of the most favourable macroeconomic environments among OECD countries, with the fastest growth rate of per capita income over the past 25 years. The Korean economy is highly dependent on exports, which account for more than half of the GDP. Korea also improved the governance of formal institutions and regulatory environment, which is a fundamental pre-condition both to encourage public and private investment in the economy and to enable those investments to achieve the intended benefits. Despite a series of deregulations, some entry barriers to agriculture remain, particularly in terms of ownership of farmland and investment in the corporations that own farmland. Promoting investment partnerships between producers and participants in the food supply chain (retailers, manufactures and others) is a key channel of innovation as it often allows farmers to respond to market demand and to introduce new technology, products or business models.

Korea maintains a relatively open trade and investment environment, although some restrictions remain in some sectors, including agriculture. Korea took a number of steps to liberalise foreign direct investment, reflected in the largest improvement in the OECD's Foreign Direct Investment (FDI) Regulatory Restrictive Index between 1997 and 2010. However, FDI in some of the agricultural sectors is still restricted and the FDI inflow to the food and agricultural sector is lower than most of the OECD countries. Korea has been actively pursuing bilateral and regional trade agreements and has developed both the physical and institutional infrastructure to facilitate trade.

Enforcement of fair competition has been a policy issue in Korea, particularly because the economy is dominated by conglomerate business groups. Ensuring a competitive environment in agricultural input and output markets is an important condition to provide competitive goods and services to meet the sector's demand. Since its establishment in 1961, the agricultural co-operative (NongHyup, NH) has played a major role in supplying farm inputs and finance and has helped small scale producers to overcome their weak market position through collective activities. The government has been providing preferential tax to NH and uses it as a channel for subsidised credit programmes. However, with an increasingly polarised farm structure, NH is facing challenges to reflect producers' diverse needs. The dominant position of NH in the supply of certain inputs (e.g. fertilisers) and financial services may hinder the entry of other players who could address the specific needs of large-scale commercial farmers.

Korea has a relatively well-functioning financial market and farmers have access to various financial sources, including emerging direct financing channels such as private investment funds. The government has been providing low-cost loans through NH. Although the

government credit programme stimulated small-scale producers to invest in farm equipment, it may have led to over-investment, which subsequently constrained productivity improvement at the farm level and caused a structural farm debt problem after the financial crisis of the late 1990s.

Korea imposes relatively low tax rates on enterprises and provides tax incentives to encourage R&D investment. The tax incentive for R&D in Korea is particularly high and the share of tax expenditure in GDP in Korea is among the top group of OECD countries. The agricultural sector enjoys a number of tax benefits: primary agricultural products are exempted from value-added tax (VAT) and agricultural inputs including fertiliser, plant protection, farm machine and feed face either a zero VAT tax rate or are entitled to a VAT refund. In addition to reduced electricity charges for agricultural use, fuel tax is also exempted for certain farm machines. While those measures lower the production costs for farmers, such special treatment may encourage the overuse of potentially environmentally harmful inputs such inorganic fertilisers, chemicals and fuels. Moreover, it may discourage appropriate financial management of the farms in recording revenue and expenditure.

Recommendations to develop economic and institutional environment for fair and open competition

- Remove the remaining restriction on the investment in agricultural corporations in order to promote innovation through vertical co-ordination in the supply chain and attract more private investment in primary agriculture.
- Strengthen enforcement of the existing Anti-Monopoly law to ensure fair competition between the NH group and other private agricultural service and input suppliers. Accounting of NH's banking service should be separated from the rest of its operations, including at the regional level.
- Reform the tax system, which reduces the cost of agricultural inputs, to promote more sustainable agriculture and facilitate good financial management at the farm level. In particular, tax exemptions on some inputs such as chemical fertiliser, plant protection and fuel as well as reduced electricity charges may encourage the use of potentially environmentally harmful inputs.

1.4. Ensuring efficient and sustainable use of agricultural resources

Korea has developed a competitive transportation infrastructure and a particularly well-developed information and communication technology (ICT) infrastructure. The government promotes the use of ICT through a "Smart Agriculture" project which targets the competitiveness of Korean agriculture. Collaboration between producers, retailers, R&D institutions and ICT industries is a key to developing ICT solutions to meet the demand of stakeholders and induce the adoption of ICT at the farm level.

The widening income gap between urban and rural area in the process of rapid industrialisation is a major policy concern. Structural change in the agricultural sector and diversification of income sources to off-farm employment have been the main pathways to addressing low income issues in rural areas. Despite government efforts to develop rural infrastructure and provide incentives to attract non-farm business activity to rural areas, young and skilled workers tend to leave such areas. Nonetheless, investment in rural infrastructure remains one of the key elements to attract non-agriculture industries to locate in rural areas. Increasing rural competitiveness and productivity requires a bottom-up

approach to promoting integrated investments and public services that are geared to local needs (OECD, 2016a, 2018).

While economic diversification is one of the key strategies to increase the economic viability of rural areas, the food manufacturing industry has arguably more potential to create rural employment, add more value to primary agricultural production and open more possibilities to explore export markets and meet domestic demand for value-added products. The government should enhance vertical linkages between producers and downstream industries by removing the restrictions to invest in agricultural corporations. It should also promote the diversification of farm production activities into processing and marketing farm products.

Fragmentation of farmland is a major constraint to improving the productivity of rice farming and other land-intensive agriculture. This fragmentation is accelerating in Korea due to subdivision of farmland ownership through inheritance and land conversion to non-agricultural use. Meanwhile, the high price of farmland reflects its potential non-agricultural use-value in the future. This discourages farm consolidation and encourages land abandonment, as land owners have an incentive to maintain land for future conversion to non-agricultural use.

Despite policy efforts, concentration of land in large farms is slow in the crop sector. The strong protection of farmland ownership is based on the principle that cultivators should own farmland. This restricts farmland lease in all but exceptional circumstances. This strong restriction on leasing farmland discourages land owners from doing so on the basis of formal contracts. The area-based direct payment increases the incentive for the land owners to rent out land informally and receive payments. Meanwhile, informal land lease contracts are often unstable and short-term, which discourage stable farm management and long-term investment.

Farmers usually receive their irrigation water either from Korea Rural Community Corporation (KRC), a public company, or from the local governments. In regions where KRC provides irrigation water, there is currently no irrigation price and the water is free; in others, the price of water does not recover operations and maintenance charges, unlike in other OECD countries. This system encourages farmers to continue using water despite increasing water stress – already very high relative to other OECD countries – and demand from other sectors. It also reduces the incentive to adopt water-saving technologies to reduce unsustainable use of water in the face of climate change, as well as diversification of production away from paddy rice production.

Korea's well-functioning labour market gives its agri-food sector the flexibility to adjust quickly to changes in labour- and skills needs, but the country will increasingly face labour shortage problems, including in the agricultural sector. The capacity of the agricultural sector to attract skilled labour from both domestic and foreign origins is crucial for its sustainable productivity growth. Promoting corporate organisational forms of agricultural operation will facilitate the entry of young generations from outside agriculture based on formal employment contracts.

A compulsory national pension system for farmers has only recently been introduced in Korea, where social protection of farmers is low and not at the same level as for other parts of society. The commodity-specific support to rice is providing some income security for older farmers – nearly 60% of rice farmers are over 65 years old – but this could be better achieved by a general social security system. The current support policy including market price support and direct payment programmes gives older farmers a strong incentive to

continue farming and to delay farm succession. This is reducing the effectiveness of policies to facilitate the early retirement of aged farmers, such as the early retirement payment and farm pension programme. Policy coherence could be improved to provide consistent incentives to encourage the voluntary retirement of aged farmers and guarantee an income source for the retired farmers.

The intensity of expenditure for public education in Korea is one of the highest among the OECD countries. The government is also increasing investment in improving the quality of education in rural areas. While the enrolment rate to higher education reached 69%, the education system in Korea is degree-oriented and professional education for agriculture is attracting relatively less attention.

Recommendations to ensure efficient and sustainable use of agricultural resources

- Promote partnerships between ICT industries and stakeholders in the food supply chain to develop demand-driven ICT in agriculture.
- Provide more fiscal and regulatory authority to local governments and increase public investment to develop high quality rural infrastructure on education, healthcare and transportation to promote more integrated investments and public services that are geared to local needs, thereby attracting the relocation of non-agriculture industries to rural areas.
- Reform the property tax system to provide incentives for the succession of farms to a single successor and to promote land transfer to younger farmers.
- Impose higher property tax on unutilised farmland to promote efficient land use.
- Facilitate formal land lease contracts by revising the farmland regulations to promote tenant farming and penalise undocumented land rental transactions.
- Ensure that charges for water supplied to agriculture at least reflect full supply costs, and ideally cover the opportunity cost of water withdrawals. Consider targeted actions to increase the resilience of agriculture to future water risks associated with climate change, increased water demand and water pollution.
- Speed up measures to control water pollution from agriculture, and further reduce point discharges from livestock enterprises, including through greater utilisation of manure.
- Consider additional incentives in the National Pension (NP) system to promote early retirement and resource transfer to young commercial farmers, for example, in return for imposing age limitations to income support payments for rice farming.
- Develop a policy environment conducive to voluntary retirement of aged farmers. The National Pension and basic old-age pension should also function as an income safety net for elderly farmers, instead of farm support payments.
- Transform the agricultural education system to focus on skills required in the sector, and not only on formal qualifications.

1.5. Developing a coherent agricultural policy leading to long-term productivity growth and sustainability

According to OECD estimates, Korea grants one of the highest levels of agricultural support and protection to its farmers among OECD countries. While Korea increased investment in the agricultural knowledge and innovation system and introduced some income support payments which are decoupled from current commodity production, the overall portfolio of agricultural policy in Korea is largely dominated by measures linked to staple production and to supporting farm income. Korea has scope to further reallocate public resources towards investments to increase long-term productivity growth and sustainability in agriculture.

The level of producer support in Korea declined gradually from 70% of gross farm revenue in 1986-88 to 49% in 2014-16. However, policy measures linked to individual commodity production account for more than 90% of support to producers. This structure of support may constrain farmers' responses to market signals, hinder structural adjustment of the sector toward production of more value-added products and increase environmental pressure from agriculture. Reform in agricultural policy to move away from intervention and towards encouraging flexibility in commodity production would facilitate structural change toward more market-oriented agricultural production.

A more open market environment is likely to increase the demand for tools to manage unexpected and unavoidable income shocks. A programme that offers payments in the event of a fall in commodity prices is currently in place for rice. However, such counter-cyclical support payments lead to an imperfect transmission of market signals to producers. If they are linked to specific crops, such measures tend to work against on-farm risk management strategies, including the diversification of production.

The agricultural insurance scheme has increased its commodity coverage to 74 agricultural products. However, the programme is highly dependent on government subsidies. The high level of insurance subsidies may lead to unsustainable choices of production and farm practices in the short term and to crowding out of better practices to adapt to changing climate in the long term (OECD, 2016b). In general, insurance subsidies risk crowding out market-based solutions and own-farm risk management strategies, and thereby transfer to taxpayers a part of the risks that should be borne by farmers (OECD, 2011). The subsidy rate should be gradually reduced for more commercially viable insurance products. The role of the private sector in providing agricultural insurance services can be enhanced by making the existing insurance database accessible to private insurance providers.

In Korea, income from the production of grains and other human food crops is exempted from income taxation, and income from plant cultivation is not taxed if the revenue is less than KRW 1 billion (USD 0.9 million). In addition to commodity-specific support, this preferential income tax treatment could impede resource reallocation towards more profitable and competitive non-grain agricultural sectors. Moreover, such exemption reduces farmers' incentive to record and manage their farming business activities through bookkeeping. The lack of income tax records constrains the government to design more targeted policies to address low-income or income variation issues. For example, low-income farmers find it difficult to benefit from the income safety-net programme (National Basic Livelihood Guarantee, NBLG). In the absence of income tax records, the introduction of more targeted income-contingent payments or tax incentives to smooth income fluctuation is difficult to implement in Korea.

The majority of Korea's farm households depend on income from off-farm activities. The low income of farm households is partly a consequence of limited non-farm employment opportunities in rural areas as well as low social security coverage. The issue of structurally low levels of farm household incomes should be addressed by a broader rural development policy to create more off-farm employment opportunities in rural areas. In addition, the general social security policy should function as an income safety-net for farmers in financial difficulty and increase the linkage to agricultural policy objectives. For example, the National Basic Livelihood Guarantee is a general social welfare programme in Korea, but only a very small number of farmers are covered by it; this is due to their ownership of agricultural production assets such as farmland, and the lack of income declarations that would allow for means-testing.

Korea has strengthened its environmental regulations and the stringency of its environmental policy is above the OECD average. The general environmental regulation system in Korea evolved from direct controls or command-and-controls in the 1980s to the combination of direct control and incentive systems since the early 1990s. Currently there is no environmental regulation imposed specifically on agricultural production, except for the regulations on livestock manure. Most of the regulations in the agricultural sector are regulations on products and processes such as regulations on food safety, labelling of origin, and traceability.

The design of agri-environmental policy requires the definition of reference levels, and environmental targets play a crucial role in choosing policy instruments. The reference level is the minimum level of environmental quality that farmers are required to provide at their own expense, and environmental targets represent a higher desired level of environmental quality. To establish a solid framework of agri-environmental policies, Korea should clarify the reference environmental quality as well as environmental targets which are well adapted to local ecological conditions. The subsidisation of chemical inputs for agriculture is not coherent with achieving agri-environmental policy objectives.

Livestock manure is the main agricultural source of water and soil pollution in Korea. Considering the future growth potential of the sector, improving the policy framework to manage livestock manure is a priority. A more comprehensive policy approach beyond regulation is also necessary: in this regard, the policy experience of the Netherlands in combining regulatory and economic incentives with a partnership of diverse stakeholders is particularly relevant.

Korea can give greater consideration to a wider set of policy instruments to promote environmentally friendly agriculture and preserve the ecosystem. So far, the country's long-term plans to improve the agricultural environment have been implemented mainly through producer incentives. However, room remains to improve the environmental performance of the sector, especially given the high surplus nitrogen and phosphate levels, and the water-use intensity in agricultural production. Environmental policies should increasingly build on the "polluter pays" principle. Direct payment schemes should be decoupled from production decisions and reoriented toward measures to target explicit societal objectives, such as the provision of environmental services including water management, flood buffering and biodiversity.

Recommendations to develop a coherent agricultural policy conducive to long-term productivity growth and sustainability

- Rebalance the portfolio of agricultural support to public investment towards long-term productivity growth and sustainability, such as more targeted support which encourages, or is conditional on, provision of environmental services (e.g. water management, flood buffering, biodiversity protection).
- Gradually reduce border protection and commodity-specific support in a predictable way in order to allow markets play their role in allocating production resources to more high value-added niche products in which Korea has a potential export advantage and the domestic demand grows further.
- Increase the role of the general social welfare programme (the National Basic Livelihood Guarantee) as an income safety net for farm households by adjusting eligibility criteria (e.g. excluding their agricultural production assets or requiring farm households to sell farmland to KRC and lease back).
- Consider taking steps to induce farmers to declare income situation to facilitate the self-evaluation of the financial performance of the farm and to allow the government to design more targeted policies such as social welfare and income-based payments. The reform could begin with introducing an incentive measure such as making certain payments conditional on income declaration.
- Evaluate the performance of the agricultural insurance premium subsidy to ensure it does not crowd out farmer's own risk management strategy, and to monitor if it is hindering the development of agricultural insurance markets. The level of subsidy should be gradually reduced for more commercially viable insurance products, in order to increase the role of the private sector in providing agricultural insurance services.
- Review existing agricultural policy instruments to improve their coherence with policy objective in order to reduce the conflicting incentives generated by different programmes. For example, policies to encourage early retirement have limited impacts as long as other policies such as market price support and direct payment create a strong incentive to continue farming.
- Establish a framework of agri-environmental policies clarifying the reference environmental quality as well as environmental targets. Regulatory measures as well as a monitoring system should be applied at the farm level, clarifying the minimum (mandatory) levels of environmental quality with which farmers need to comply.
- Apply economic instruments such as emissions trading schemes to reduce the intensity of chemical inputs and foster expansion of integrated nutrient management (such as nutrient accounting at the farm level); provide incentives to develop and disseminate technologies that improve fertiliser usage (e.g. nitrification inhibitors, cover fertilisers, etc.).
- Take a multi-dimensional approach to manure management, including regulation, incentives to invest in developing new technology, capacity building and building partnerships between stakeholders. Enhance the partnership between livestock and crop farms to recycle and re-use livestock manure through on-farm

application, biogas production and composting into organic fertilisers, and transport manure from livestock farms with a nutrient surplus to arable farms.

- Formulate a roadmap with emission reduction goals and detailed measures to implement the 2030 GHG emission reduction target for the main emission sectors (rice and livestock). Set intermediate steps to track progress towards the targeted path and adjust measures if necessary.
- Integrate climate change adaptation and mitigation as a cross-cutting aspect of agricultural and agri-environmental policies.

1.6. Establishing a more collaborative agricultural innovation system among public and private actors

Korea has increased public investment in agricultural R&D remarkably over time, and the intensity of this investment is one of the highest among OECD countries. This is reflected in its share of scientific publications in agriculture and food, which recently exceeded both OECD and EU15 averages. The country's agricultural productivity and sustainability can benefit more from this high level of R&D investment.

Korea's current agricultural innovation system (AIS) is characterised by the dominance of public actors such as public research institutions and public extension services, and the limited role of private research and technical advisory services. In some countries agricultural innovation is increasingly taking place in a network-based setting, in which a more inclusive, interactive, and participatory approach fosters greater innovation in response to emerging and pressing challenges facing food and agriculture systems. However, network analysis among AIS actors in Korea shows a weak connection between the private sector, producers and governments. The AIS in Korea should evolve to a more collaborative and demand-driven system between public and private sectors including higher education institutions.

Despite the establishment of the Science and Technology Commission of Food, Agriculture, and Forestry (STCA) as a co-ordinating institution, the complex public agricultural R&D system in Korea involving the Rural Development Administration (RDA), Ministry of Agriculture, Food and Rural Affairs (MAFRA) and Korea Forest Service (KFS) is increasing the difficulty of co-ordination and collaboration between different public institutions involved in agricultural R&D at multiple administrative levels.

While Korea has the highest intensity of private R&D investment among OECD countries, its level of private R&D investment in agriculture is relatively low. Efforts were made to increase the participation of private enterprise in public R&D projects through a matching fund and a voucher system. However, the high level of public R&D investment may reduce the incentives for the private variety. The role of public agricultural R&D should be redefined so that it is concentrated more on the pre-competitive stage or on areas of public interest (such as long-term environmental sustainability), which are complementary to private R&D. Moreover, the tax incentive for private R&D in agriculture is much lower than other sectors as most farmers and agricultural corporations are exempted from income tax.

Another shortcoming of the top-down R&D system is that its outputs are not necessarily adopted at the farm level and do not address the practical needs of producers and food industries. The experience in OECD countries shows that enhancing the partnership

between various public and private actors would increase the efficiency of public R&D investment and help secure contributions that are more adapted to both public and private needs.

As the farm population has become more diverse and produces more high-value-added niche products, the standardised services of the public extension system have limited capacity to meet producers' needs. Although the government uses subsidies to encourage the use of private technical services, the development of those services is still limited. Extension services in some OECD countries have evolved to a more competitive system that mixes both public and private providers and is demand-driven, more pluralistic and decentralised. Korea's public extension services should be reoriented towards issues of public interest such as animal disease prevention and environmental protection; this would allow more diverse private companies to provide services.

Recommendations to establish more collaborative agricultural innovation system among public and private actors

- Strengthen STCA's function as the R&D control centre of the sector to improve the co-ordination between RDA, MAFRA and APQA, and to evaluate public R&D projects.
- Allow the participation of a wide range of stakeholders in public R&D planning and evaluation processes to reflect their technical demands.
- Concentrate public R&D activities more on areas of public interest such as environment and resource conservation, and on areas where the private sector would under-invest, such as basic and pre-competitive applied areas of research, and commercially less viable commodities.
- Promote collaboration between different actors in the agricultural innovation system. Public agriculture R&D projects can increase their conditionality on collaboration with the private sector, higher education institutions and other public R&D institutions. Joint research projects with non-agricultural research institutes should also be facilitated to combine science and technology in agriculture and other fields.
- Enhance the agricultural R&D capacity at the local level by establishing a public-private council for regional agricultural technology innovation and improve the co-ordination between the central and local governments through co-funding schemes.
- Reorient the public extension system towards providers of technical services that private organisations have less incentive to provide, such as promoting sustainable production practices, thereby leaving more room for private technical service providers, intermediary organisations such as farmers' co-operatives and industry associations in transferring technologies, capital and information.
- Increase the exploitation of interactive learning to expand the innovation capability of farmers. Promote participatory test-farm projects with public R&D institutions and universities to increase linkage and share experiences among farmers.

Note

[1] The Oslo Manual defines innovation as the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations (OECD and Eurostat, 2005).

References

OECD (2018), *Rural 3.0. A Framework for Rural Development*, Policy Note, Paris, http://www.oecd.org/cfe/regional-policy/Rural-3.0-Policy-Note.pdf.

OECD (2016a), *OECD Regional Outlook 2016: Productive Regions for Inclusive Societies*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264260245-en.

OECD (2016b), *Innovation, Agricultural Productivity and Sustainability in the United States*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264264120-en.

OECD (2015), "Analysing Policies to improve agricultural productivity growth, sustainably: Revised framework", www.oecd.org/agriculture/policies/innovation.

OECD (2011), *Managing Risk in Agriculture: Policy Assessment and Design*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264116146-en.

OECD and Eurostat (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, 3rd Edition, The Measurement of Scientific and Technological Activities, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264013100-en.

Chapter 2. Overview of the food and agriculture situation in Korea

This chapter describes the overall economic, social and environmental context in which the food and agriculture sector in Korea operates, and the natural resource base upon which it relies. It provides an overview of the general geographical and economic characteristics of Korea; outlines the share of the agri-food complex in the economy; identifies the main structural characteristics of the food and agriculture sector; provides an overview of the main food and agriculture outputs and markets; and analyses the main trends in agricultural productivity, competitiveness and sustainability. It finally raises a number of issues the agri-food complex is likely to face in the future.

2.1. General natural and economic context

General economic context

Remarkable economic growth in the last four decades has made Korea one of the largest economies in the world (Table 2.1). The level of GDP per capita increased from 65% of the OECD average in 2000 to 86% in 2015. Korea achieved the fastest growing per capita income among the OECD member countries over the past 25 years (OECD, 2016a).

Korea's economic growth has been led strongly by its exports, which account for more than half of GDP. Sustaining double-digit growth in exports made Korea the sixth largest exporter in the world. Its domestic market is relatively small and the economic dependency on exports is large. The country's competitiveness in export markets is particularly important for its sustainable economic growth.

Korea is scarce in both land and water resources. It has the highest population density and the lowest availability of arable land per capita among OECD countries (0.03 ha in 2013) (World Bank, 2016). As of 2015, the total cultivated area in Korea was 1.7 million ha. Farmland takes 17% of the total land area. Despite intensive efforts to increase this area through drainage, irrigation and reclamation, the cultivated area has tended to decline due to industrial and urban development. The share of cultivated land in total land area fell from 22% in 1980 to 17% in 2015. Of the 1.7 million ha of cultivated land, 54% is paddy field and 46% is upland. Freshwater resource per capita is also one of the lowest among the OECD countries. The limited land and water resource endowment in Korea leads to strong competition in the use of land and water between agriculture and other sectors.

Table 2.1. Contextual indicators

	GDP	GDP per capita	Population	Total land area	Agricultural land	Arable land per capita	Freshwater resources	Freshwater resources per capita
	billion USD in PPP**	USD in PPP**	million	thousand km^2	thousand ha	ha	billion m^3	m^3
	(2015*)	(2015*)	(2015*)	(2013*)	(2013*)	(2012*)	(2013*)	(2013*)
Korea	1 748	34 518	51	97	1 769	0.03	65	1 291
(world ranking)	*(13)*	*(34)*	*(25)*	*(99)*	*(121)*	*(162)*	*(65)*	*(111)*
Australia	1 103	45 821	24	7 682	396 615	2.07	492	21 272
China	18 998	13 171	1 402	9 425	515 358	0.08	2 813	2 072
EU28	19 191	37 691	509	4 238	186 356	0.26	1 505	4 740
France	2 648	39 813	65	548	28 774	0.28	200	3 033
Germany	3 848	47 167	81	349	16 697	0.15	107	1 327
Japan	4 738	37 372	127	365	4 537	0.03	430	3 377
Netherlands	821	48 472	17	34	1 848	0.06	11	655
United Kingdom	2 692	41 351	65	242	17 250	0.10	145	2 262
United States	17 947	55 798	321	9 147	405 437	0.49	2 818	8 914
OECD	50 947	39 976	1 272	34 341	1 211 805	0.30	10 466	28 117

Note: * or latest available year; ** PPP: Purchasing Power Parity.
Source: FAO (2016a), FAOSTAT (database), Food and Agriculture Organization of the United Nations, http://faostat3.fao.org/home/E; OECD (2016b), OECD.Stat (database), http://stats.oecd.org/; World Bank (2016), World Development Indicators (database), http://data.worldbank.org/indicator.

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Korea achieved remarkable growth throughout the 1960s to the 1980s, when the annual growth rate of real GDP often exceeded 10% (Table 2.2). The political crisis and oil shock in 1980, when Korea experienced a negative growth in real terms, was the only exception. However, economic growth has gradually slowed since the 1990s with the country achieving high-income status. Korea experienced a financial crisis at the end of 1997 as part of the regional financial crisis, but quickly recovered its growth path in the early 2000s.

More recently, annual real GDP growth slowed to 2.8% in 2011-2015. The slowdown in world trade since 2010 has been especially detrimental to Korea, as exports account for nearly 60% of total demand (OECD, 2016a). Nonetheless, Korea maintains a higher growth rate than the OECD average. This sustained high economic growth demands a rapid change in Korea's economic structure, and the role of policies to assist the process of structural adjustment is particularly important.

Table 2.2. Real GDP growth*

	1981-85	1986-90	1991-95	1996-2000	2001-05	2006-10	2011-15
Korea	9.4	10.0	7.4	4.7	4.8	3.8	2.8
Australia	2.7	3.9	3.1	4.3	3.6	2.8	2.9
China	12.1	7.7	13.1	8.3	10.1	10.9	7.6
EU28	2.0	3.5	1.7	3.2	1.8	0.3	0.4
France	1.7	3.6	1.3	3.3	1.6	0.4	0.3
Germany	1.6	3.6	1.3	2.2	0.3	0.6	0.8
Japan	4.3	5.5	0.9	0.4	1.4	0.0	1.1
Netherlands	1.6	3.5	2.3	4.5	1.1	0.7	-0.2
United States	2.0	3.5	1.7	3.2	1.8	0.3	0.4
OECD	2.9	3.8	2.3	3.5	2.5	0.6	1.5

Note: * Annual percentage change.
Source: World Bank (2016), World Development Indicators (database), http://data.worldbank.org/indicator.

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Demographic change

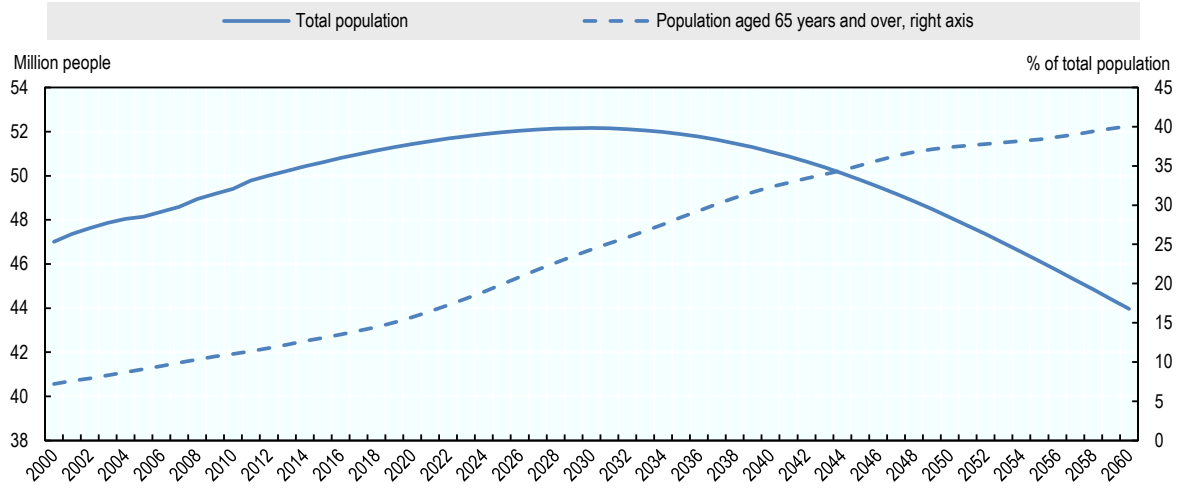
Projections for demographic change have important implications for the Korean economy. The population expanded by 2.3 times in the last 60 years, but the annual growth rate has declined from around 2% to 0.5% after 1990 (KREI, 2015). The total fertility rate has declined to 1.23 children per woman and has become one of the lowest in the world. According to official projections released by Statistics Korea, the population in Korea is expected to peak in 2030 (Figure 2.1).

As a result of a low fertility rate and a longer life expectancy, Korea is experiencing rapid ageing, which is expected to continue in the long-term. The share of population over 65 years old is expected to increase from 14% to 30% in the next 20 years. Similarly, the elderly dependency ratio (percentage ratio of over 65 years old and the 15-64-year-old population) is expected to rise from 18% to 72% in 2014-50, which is the highest growth rate among all OECD countries. The demographic change in Korea is so rapid that its population is expected to go from the fourth youngest in the OECD in 2012 to the third oldest by 2050 (OECD, 2016a). The working age population between 15 and 64 years old started to decline in 2017 and is expected to decline by 15% between 2010 and 2040.

The ageing of the population has advanced quicker in rural areas, where young generations have migrated to urban areas. The elderly dependency ratio (the ratio of over-65-year-old

population over the working age population) among the rural population is already 19%, as opposed to 12% in predominantly urban areas (OECD, 2017a). The elderly dependency ratio increased to 27% in rural areas, which is above the national level of 19%. In 2010, the ageing index (ratio of over 65 years-old population over the population below 15 years old) of cities (*Dong*) and rural areas (*Eup* and *Myeon*) were 55.7% and 145.7%, respectively (KREI, 2015).

Figure 2.1. Projection of Korea's demographic structure, 2000 to 2060



Source: KOSTAT (2012), Population Projections and Summary indicators (Medium projection) Statistics Korea.

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2.2. Importance of agriculture and the food sector in the Korean economy

The remarkable growth of the Korean economy in the last four decades drastically changed the role of agriculture. Until the 1960s, agriculture generated almost half of Korea's GDP. In 1970, agricultural production continued to contribute 25.5% of GDP and the labour force employed in the agricultural sector accounted for 50.5% of the country's total labour force (OECD, 2008). As the industrialisation process progressed, however, the share of agricultural production in GDP declined to 2.1% in 2014 (Table 2.3). Similarly, agriculture's share of employment fell to 6.1%. Despite this decline, agriculture accounts for relatively larger shares of GDP and employment compared to other OECD countries. Agriculture continues to be a main user of land and water in Korea, indicating a major role of agriculture in natural resource use.

As a large net importer of food products, agro-food imports are important in Korea's overall trade balance. They represented around 18% of merchandise imports in 1970 but dropped to 5% in 2015 as non-agricultural imports grew at a much faster rate. The share of agro-food products in total exports declined significantly to less than 1% in 2015, showing a marginal role of agriculture in total exports.

Table 2.3. Importance of agriculture in the economy, 2014*

	Gross value added	Employment	Exports	Imports	Total land area	Total water withdrawals
			Per cent			
Korea	**2.1**	**6.1**	**1.0**	**4.9**	**18.4**	**54.7**
Australia	2.2	2.6	15.2	5.7	52.8	65.7
China	9.5	29.5	2.2	6.2	54.8	64.6
EU28	1.4	5.8	6.7	6.0	43.0	19.2
France	1.6	2.5	13.3	8.8	52.7	9.5
Germany	0.6	1.7	5.9	8.0	47.8	0.6
Japan	1.2	3.8	0.4	7.4	12.5	66.8
Netherlands	1.7	1.9	17.8	13.0	54.6	1.1
United States	1.4	1.5	11.0	5.0	44.7	40.2
OECD	1.9	5.2	8.6	7.6	39.5	30.6

Note: * or latest available year.
Source: OECD (2016d), System of National Accounts, OECD Annual Labour Force Statistics; UN Comtrade (2015), United Nations Commodity Trade Statistics (database), http://comtrade.un.org/; FAO (2015a), FAOSTAT (database), Food and Agriculture Organization of the United Nations, http://faostat3.fao.org/home/E, FAO (2015b), AQUASTAT Main Database, Food and Agriculture Organization of the United Nations.

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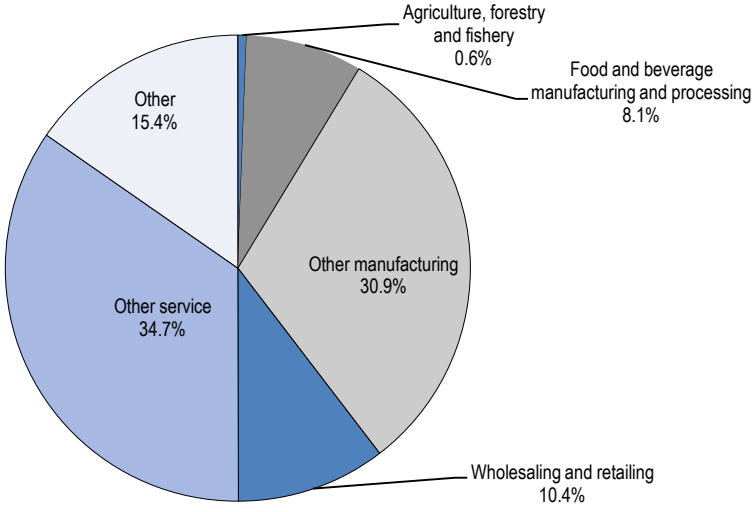
Despite agriculture being one of the main activities in rural areas, it is not a main employer there (Figure 2.2). Kim et al. (2014a) showed that the service sector is the largest employer (45%), followed by manufacturing (39%, of which processing and manufacturing of food accounted for 21%). By contrast, agriculture, forestry and fisheries accounted for only 0.6% of employment and declined by 7.6% annually from 2000 to 2011, while employment in manufacturing and services increased by more than 3% annually.

Figure 2.2. Employment status in Korean rural areas, 2011



Note: Numbers may not add up to 100 due to rounding.
Source: Kim et al. (2014a).

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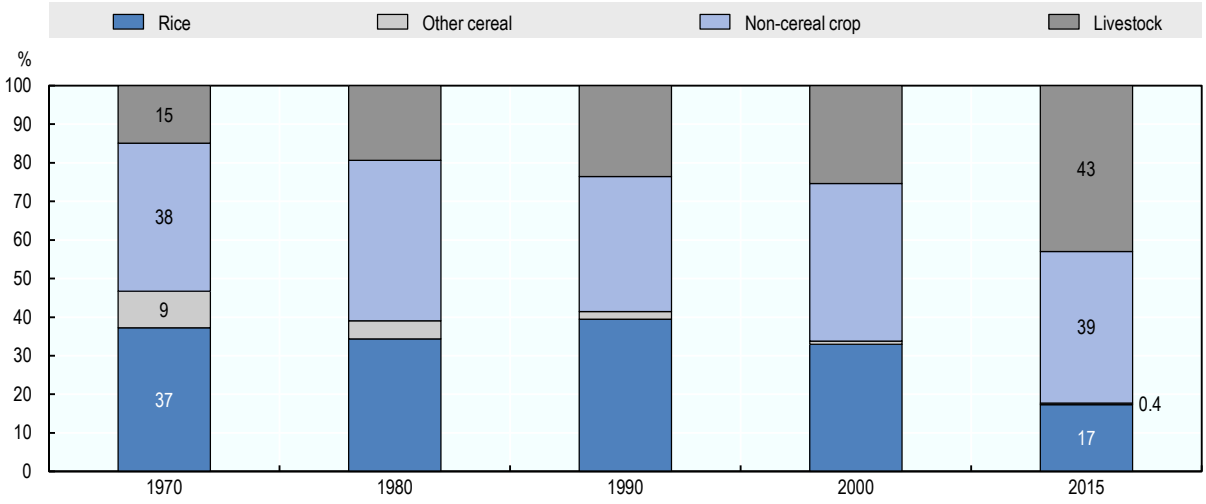
2.3. Characteristics of the Korean agriculture and agri-food sector

Primary agriculture production

Responding to a growing domestic demand, agricultural production in Korea more than doubled between 1970 and 2000. However, the expansion of agricultural output has stagnated since the early 2000s. At this stage, a higher level of income no longer increased food consumption in a quantitative term, but shift to more value added products is likely to continue. Moreover, trade liberalisation in certain commodity markets may have limited growth in domestic agricultural production.

The structure of agricultural production has evolved significantly during the last decades. Rice was by far the most important single product and the dominant grain in Korea, as shown by its contribution to agricultural production and land use. The importance of rice in the value of agricultural production decreased rapidly over the last 45 years: from 37% in 1970 to 17% in 2015 (Figure 2.3). Rice production peaked at 6 million tonnes in 1988 and then declined to 4.2 million tonnes (on a milled rice basis) by 2015. During this process, the production of a high-yield rice variety was abandoned (OECD, 2008). Despite a smaller share of rice in agricultural production, rice production still accounts for approximately half of Korea's cultivated land area.

Figure 2.3. Composition of agricultural production value in Korea, 1970 to 2015



Note: Numbers may not add up to 100 due to rounding.
Source: MAFRA (2016a).

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While cereal production has declined over time, the shares of fruits and vegetables, and livestock products in agricultural production have increased. The main fruits and vegetables produced in Korea are apples, pears, mandarins, persimmons, grapes, peaches, garlic, red pepper, onion, Chinese cabbage, radish, cucumber, watermelon, tomatoes, and strawberries. Additionally, ginseng is an important specialty product.

The livestock sector experienced the highest growth among the agricultural sectors in the last four decades. The value share of livestock products in agriculture increased from 15%

to 43% in 1970-2015, which contrasts with rice production. Domestic livestock is dependent on imported feed, with feed maize constituting the country's top agricultural import (FAO, 2016b). While livestock now generates nearly a half of the total agricultural production value, only a small proportion of the farm population is engaged in it. Of 1.9 million farm households in 2015, beef cattle farms accounted for 8.7%, dairy cattle for 0.5%, pigs for 0.4% and chickens for 0.3% (KOSTAT, 2016a).

Food manufacturing industry

Korea's food industry, which includes food manufacturing and services, is growing fast. Between 2005 and 2014, it expanded by 78% in nominal terms, while agriculture, fishery and forestry grew by 27% in the same period. Manufacturing of food and beverages shows the highest growth rate: 84%. As a result, food manufacturing now has a higher value of production than agriculture, fishery and forestry, although the value-added is still larger in agriculture, fishery and forestry (Table 2.4). Employment in the food manufacturing industry is still lower than in agriculture, forestry and fisheries, but grew at 2.4% annually in 2005-14, while employment in agriculture, forestry and fisheries declined sharply.

Table 2.4. Development of food manufacturing industry in Korea

	Value of production		Value added		Employment	
	share (%)	annual growth rate (%)	share (%)	annual growth rate (%)	share (%)	annual growth rate (%)
	(2014)	(2005-14)	(2014)	(2005-14)	(2014)	(2005-14)
Agriculture, forestry and fisheries	1.6	2.9	2.3	1.8	5.7	-2.4
Food, beverage and tobacco manufacturing	3.1	6.0	1.4	4.2	0.8	2.4

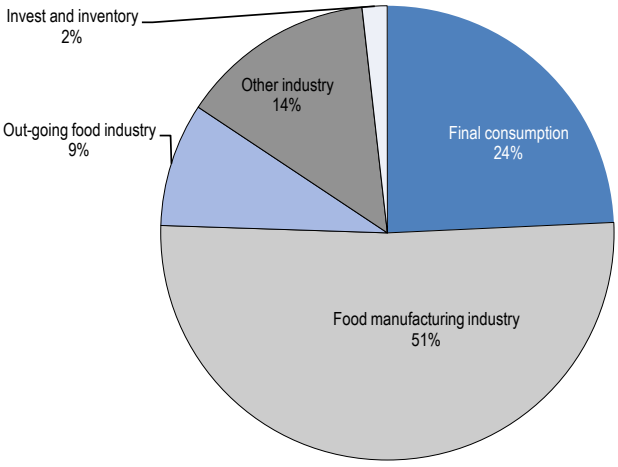
Note: The employment of food, beverage and tobacco manufacturing includes enterprises with fewer than 10 employees and excludes all of the tobacco manufacturing industry.
Source: Korea Agro-Fisheries & Trade Corporation (2016), Food Statistics 2016.

StatLink https://doi.org/10.1787/888933852160

The food manufacturing industry has a strong linkage with the domestic agricultural sector. Based on the Bank of Korea's input-output table, Korea Agro-Fisheries & Trade Corporation (2016) shows that a 1 unit increase in food manufacturing production in 2014 resulted in direct and indirect production inducements of 2.3 units of production in the economy, including 0.36 units in the agriculture, forestry and fisheries sector. The production inducement effect of food manufacturing on agriculture, forestry and fisheries is significantly higher than that of other industries.

Kim et al. (2015a) show that final consumption accounted for 24% of the total production value of primary agricultural, forestry and fishery products in 2013. This means that more than half of the value of these primary products was used as an input to the food manufacturing industry (Figure 2.4). By contrast, the share of domestic raw materials used by the food manufacturing industry was 31% in 2014 on a weight basis and 47% on a value basis. On a weight basis, domestic primary agricultural production accounted for more than 90% of the final product for Kimchi (a spicy and sour Korean dish made of fermented vegetables) and dairy. In the "other food" category, rice cake used 47% of inputs from domestic sources, but the share of domestic material for confectionery was 17%.

Figure 2.4. Destination of Korea's domestic supply of agriculture and fishery products, 2013



Source: Kim et al. (2015a).

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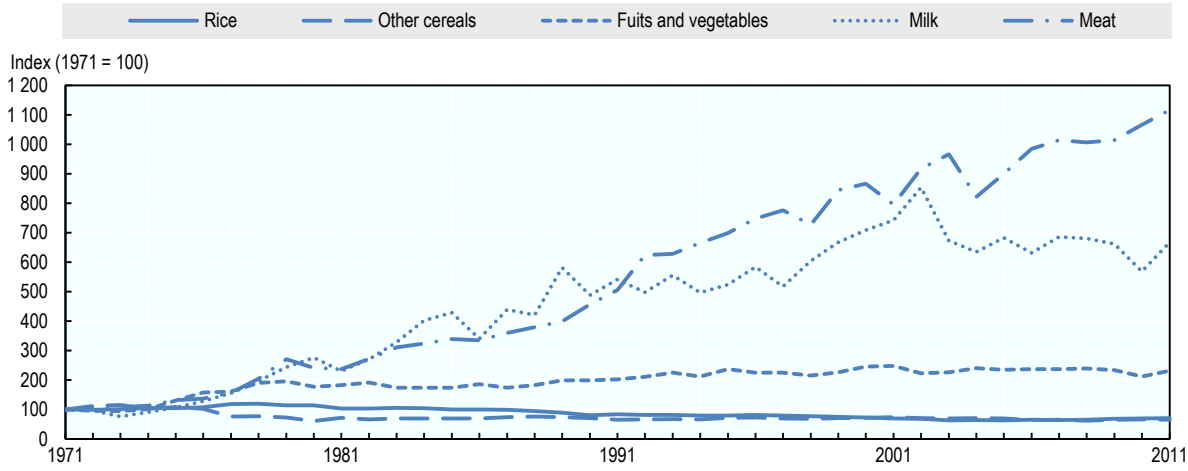
Consumption and trade

Rapid income growth in Korea diversified food consumption away from rice. Demographic shifts will have a greater impact on food consumption patterns in the future. The westernisation of diets has increased consumption of livestock products, fruits and vegetables (Figure 2.5). This dietary shift also transformed the composition of nutritional intake in Korea: the share of carbohydrate in total energy intake shrunk from 81.4% to 64.1% in 1971-2013, while the share of fat increased from 5.7% to 21.2% during the same period (KREI, 2015).

While rice continues to be a staple of the Korean diet, per capita annual consumption declined continuously from 136 kg to 62 kg between 1970 and 2016, and it is expected to fall further in the future. In contrast, vegetable consumption has increased from 60 kg to 158 kg, and fruit consumption increased from 10 kg to 67 kg between 1970 and 2015.

Figure 2.5. Food supply per capita by commodity in Korea, 1971 to 2011



Source: FAO (2017).

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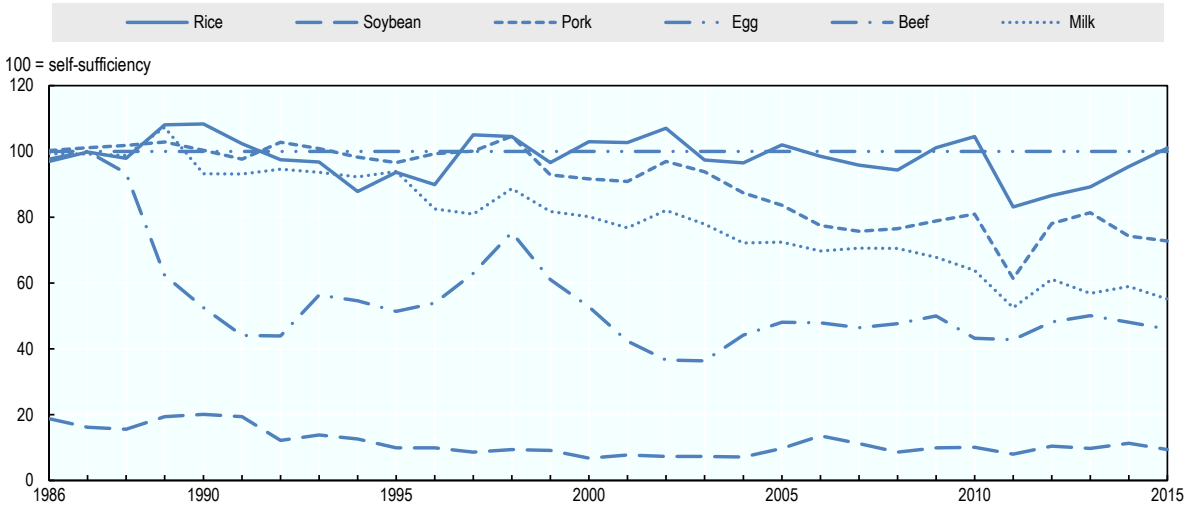
The largest demand growth has been recorded in livestock products. Per capita annual meat consumption jumped from 5.2 kg in 1970 to 46.8 kg in 2015. Pork accounts for around half of the meat consumption but beef is the most important meat on a value basis. Per capita consumption of dairy products increased from 1.6 kg in 1970 to 75.7 kg in 2015. In contrast with most OECD countries, milk is mainly consumed in fluid form. While the consumption of milk has been stable in the last two decades, the quantity of cheese consumption expanded more than 10 times between 1995 and 2015, contributing to the expansion of dairy product imports. These trends show the shift of consumption among Koreans from staple rice to more value-added livestock products, fruits and vegetables.

Korea started to import table rice in 2005 as a result of rice renegotiation at the WTO in 2004. At that time, the minimum market access quota increased from 1% to 4% of the consumption of the base year (1988-90) and Korea continues to maintain near self-sufficiency of table rice (Figure 2.6). Although soybean imports are subject to a TRQ system, domestic consumption depends largely on imports, particularly for animal feed use. Among livestock products, the domestic consumption of eggs is fully met by domestic production, but the self-sufficiency rate of pork started to decline since late 1990s. Similarly, import dependency gradually of milk increased overtime as non-fluid milk consumption increased. Cheese accounted for more than half of imports of dairy products in 2016.

Figure 2.6. Self-sufficiency rate by commodity in Korea, 1986 to 2015



Source: MAFRA (2016b), Grain Policy Data.

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Korea's agri-food exports have increased 9.9% annually since 2004, reaching USD 6 465 million in 2016. However, the growth of agri-food exports underperformed relative to the exports of other products. The value of agri-food imports increased more rapidly than exports, increasing the net import position. In 2016, Korea's agri-food imports were 4.6 times larger than its agri-food exports. Among the imports, grains including cereal grains and pulses have the largest share, reflecting its comparative disadvantage in land-intensive products (Table 2.5). Corn is the largest imported grain and is used mainly as animal feed. The United States is the largest import partner, accounting for 20% of imports, followed by the People's Republic of China (hereafter "China").

Table 2.5. Major trading commodities in Korea, 2016

Top items

	Export		Import	
	Commodity	Value (million USD)	Commodity	Value (million USD)
1	Cigarette	982	Beef	2 284
2	Beverage	334	Maize	1 909
3	Instant noodle	290	Pork	1 363
4	Coffee preparation	259	Wheat	1 023
5	Sugar	168	Soybean meal	781

Source: Korea Agro-Fisheries & Trade Corporation (2016), Food Statistics 2016.

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Japan used to be the main export market for Korean agri-food products, but its share declined from 49% in 1995 to 18% in 2016 as exports to China and Viet Nam increased. China, Japan and the ASEAN countries accounted for around 52% of Korean exports in 2016. Government and industry are exploring the opportunities for agricultural exports to exploit the rapidly expanded FTA framework and international recognition of Korean food

culture. Since the 1990s, the Korean government has been actively promoting the export of agri-food products by providing assistance at each stage of the export process: developing products tailored to local consumers' preference, providing market information, finding new buyers, conducting overseas market research.

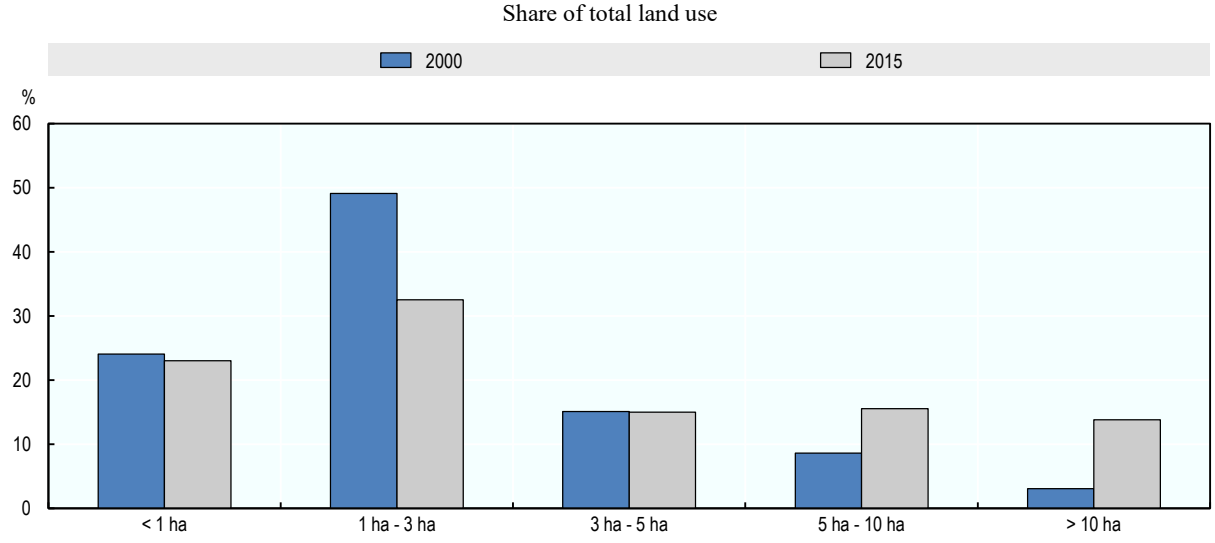
Farm structure

Farm size distribution

One of the distinguishing features of Korean agriculture is the dominance of small-scale farms. Although the average farm size per household is gradually increasing, it is still 1.5 ha (KOSTAT, 2016a). More than 69% of farms have less than 1 ha and only 8% have more than 3 ha. Most Korean farms are mixed general farms, although the number of specialised farms, notably in the production of livestock and greenhouse vegetables, has increased. Until the beginning of the 1990s, small farms and relatively big farms decreased continuously in number, while mid-sized farms increased. However, a polarised distribution of cultivated land has appeared since the 1990s: the ratio of mid-sized farms with arable land of 0.5-2.0 ha dwindled, whereas the share of farms with cultivated land areas of less than 0.5 ha and over 2 ha increased. While small size farm accounts for a large share of farms, the concentration of farmland in bigger farms is rising at a quite rapid pace.

Small scale farms have a large share among farm population but their share in total land use has decreased. In 2015, farms cultivating less than 1 ha accounted for 69% of the farm population but 22% of total land. On the other hand, farms greater than 3 ha accounted for only 8% of all farms but cultivated 44% of total land (Figure 2.7). Such polarisation of farm structure is a common feature of structural change across OECD countries (Bokusheva and Kimura, 2016). However, land use in Korea could be more concentrated to larger sized farms: the share of total land cultivated by farms of more than 10 ha increased from 3% to 14% between 2000 and 2015 in Korea, but this share rose to 48% by 2015 in Japan.

Figure 2.7. Farm size distribution in Korea, 2000 and 2015



Source: KOSTAT (2016a).

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Under the polarised farm structure, per farm average size is not an appropriate indicator to assess the degree of structural change, as it does not change if the total number of farms and the area of farmland remain constant. Considering this limitation of mean farm size, Bokusheva and Kimura (2015) used hectare-weighted median (mid-point) farm-size as an alternative indicator. The mid-point farm size corresponds to a farm size that separates the farm size distribution into two parts: 50% of the total area of the national farmland (or the total number of animals) operated by the farms of a larger size and the other 50% by the farms of smaller size than the mid-point. In Korea, the mean and midpoint farm size is particularly different for rice farms, where small-scale producers dominate the sector. While mean size of rice farms increased only by 0.3 ha in 2000-15, mid-point size increased from 1.5 ha to 2.8 ha in the same period (Table 2.6).

Table 2.6. Evolution of farm size in Korea, 2000-15

	Rice farms	Dairy farm	Beef cattle farm	Hog farm	Broiler farm	Egg farm
	ha			*number of heads*		
	mean farm size					
2000	1.0	39	22	612	..	..
2005	1.2	52	21	999	32 424	16 940
2010	1.2	72	35	1 527	32 458	22 791
2015	1.3	78	53	1 998	42 969	25 354
	mid-point size					
2000	1.5	50	50	1 200	..	..
2005	2.0	68	50	2 000	60 000	40 000
2010	2.3	81	70	2 380	61 500	55 000
2015	2.8	90	100	3 000	75 000	85 000

Source: KREI's calculation based on KOSTAT (2016a).

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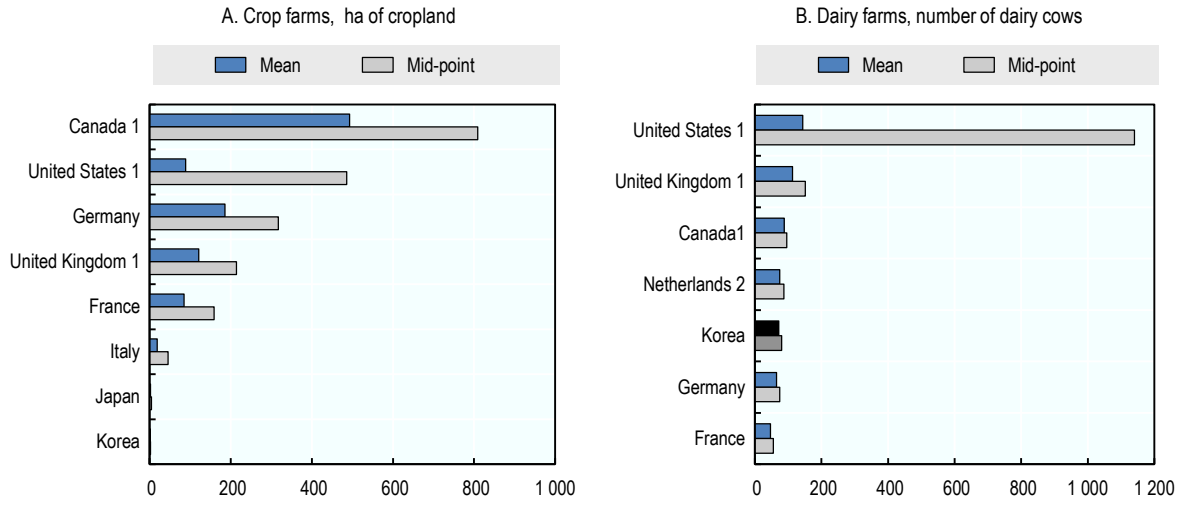
The increase in farm size was particularly rapid in livestock sectors where domestic demand has grown. The livestock sectors face fewer constraints to farm-size expansion than the land-intensive crop sector. The Korean beef cattle breed (Hanwoo) dominates the number of cattle, although dairy cattle numbers grew rapidly up to the early 1990s. In 1996, there were 2.8 million heads of Hanwoo cattle, decreasing to 1.4 million heads in 2002 in the wake of the financial crisis in 1998 and the tariffication of beef imports in 2001 (KREI, 2015). By 2012, numbers recovered to exceed 3 million heads following the restructuring of the beef sector. The growth in hog and chicken production has been significant –the number of hogs increased 192% and the number of chickens more than 217% between 1983 and 2016.

Cross-country comparisons of farm size show that the operational size of Korean livestock farms are already comparable with some EU countries, while the size of crop farms is much smaller (Figure 2.8). For example, the mid-point size of Korean dairy farms was 81 dairy cows in 2010, which is similar to countries such as the Netherlands (88 cows) and Germany (75 cows), and more than France (56 cows).

Figure 2.8. Farm size in selected OECD countries, 2010



Notes: 1. 2010 is replaced by the nearest available year: by 2009 for the United Kingdom (England), by 2011 for Canada, and by 2012 for the United States.
2. For the Netherlands, data are on all farms having cropland and dairy cows respectively.
Source: Bokusheva and Kimura (2016), http://dx.doi.org/10.1787/5jlv81sclr35-en; KREI's calculation based on KOSTAT (2016a).

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The mid-point size of dairy farms and beef cattle farms increased by 1.8 and 2.0 times in 2000-15, respectively. The expansion of hog farm size was 2.5 times in the same period, measured by the mid-point number of pigs. The herd size expansion was particularly remarkable in the poultry sector, which has become the most concentrated livestock sector and has also seen rapid development of vertical integration. In 2015, over 90% of meat chickens and meat ducks were raised within vertically integrated operations (OECD, 2016c). The mid-point sizes of broiler and egg farms increased to 75 000 chickens and 85 000 hens, respectively. However, with limited land the growth in livestock output has led to strong increases in stocking densities, increasing environmental pressure from manure emission.

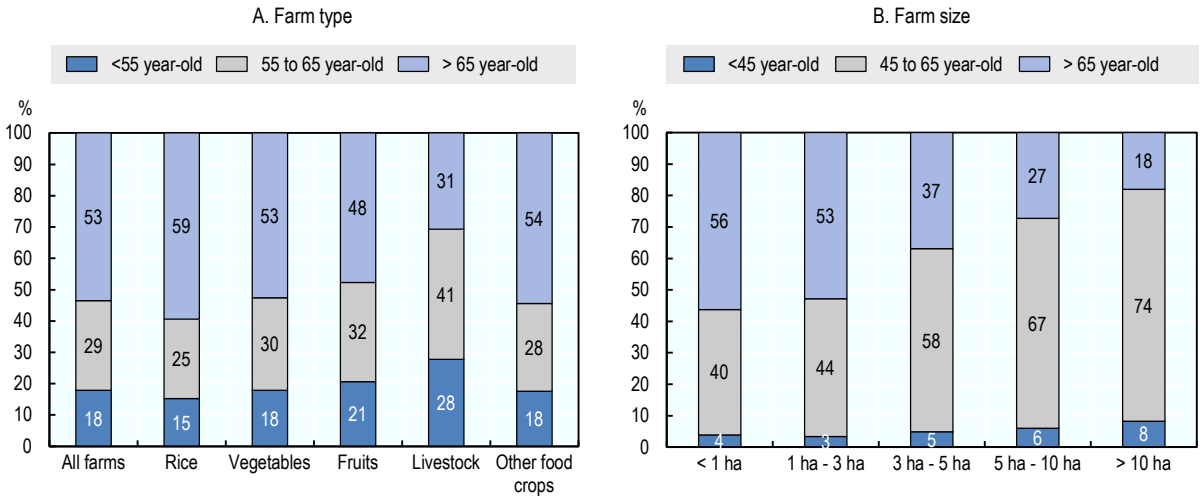
Age distribution

Declining labour input through lower farm population and mechanisation has been the main driver of productivity growth in agriculture. The number of farm households has declined more than 50% since 1970 as a result of the outmigration of younger generations to the urban areas and limited new entrants to the agricultural sector. The number of household members per farm household declined sharply from 5.8 in 1970 to 2.4 in 2015. As a consequence, ageing of the farming population advanced rapidly. The proportion of the farm population over 65 years old increased from 5% in 1970 to 38% in 2015. Agricultural activity became a form of a social safety net for the older-age rural population, as they are not sufficiently covered by the existing pension systems (OECD, 2016c).

The share of aged farmers is particularly high for rice farms, where 59% of farm managers are over 65 years old (Figure 2.9.A). In contrast, livestock farms are dominated by younger farm managers. The share of livestock managers aged over 65 was less than one-third. The average age of livestock farmers is 59.4 years old, which is significantly lower than the

average age of crop farms (66.2 years old). The age distribution by farm size class shows that small-scale farms are dominated by aged farmers (Figure 2.9.B). Indeed, in 2015 the main operators of 56% of farms less than one hectare were over 65 years old. Large-scale commercial farms are rather dominated by younger farmers.

Figure 2.9. Age of managers by farm type and farm size in Korea, 2015



Note: Numbers may not add up to 100 due to rounding.
Source: KOSTAT (2016a).

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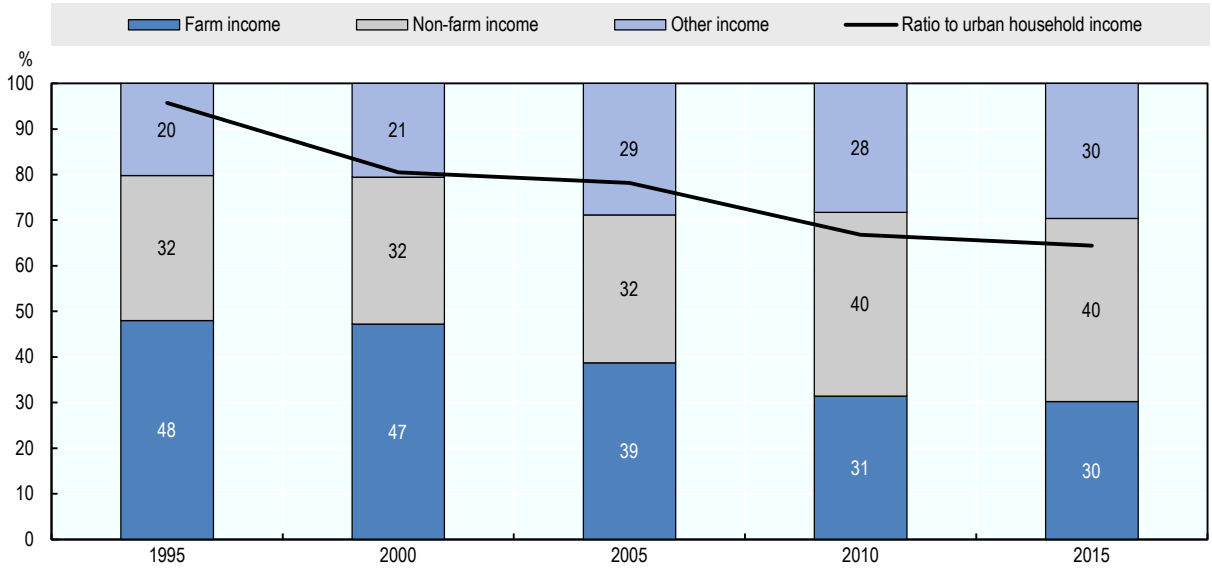
Farm household income

Farm household income in Korea grew stably after the recovery from the financial crisis in the late 1990s. Average farm household income grew annually at 0.7% in 2003-16 in real terms. This is mainly driven by an increase in non-farm income and transfer income.[1] On the other hand, average real farm income has been decreasing since the early 2000s. As a consequence, the share of farm income in farm household income declined from 48% to 30% between 1995 and 2015 (Figure 2.10). In particular, the share of farm income for side-business farms and self-sufficient farms fell to only 3.4% and 1.3% of farm household income, respectively.[2] These types of farm households accounted for 34% of the total number of farm households in 2015 (KOSTAT, 2016b). The dependency on off-farm income is much lower for livestock farms than crop farms. In 2015, the share of farm income in total farm household income was 73% among livestock farms, while it was 30% among all farm types (KOSTAT, 2016b).

Figure 2.10. Composition of farm household income and disparity with urban households in Korea, 1995 to 2015



Note: Numbers may not add up to 100 due to rounding.
Source: KOSTAT (2016b).

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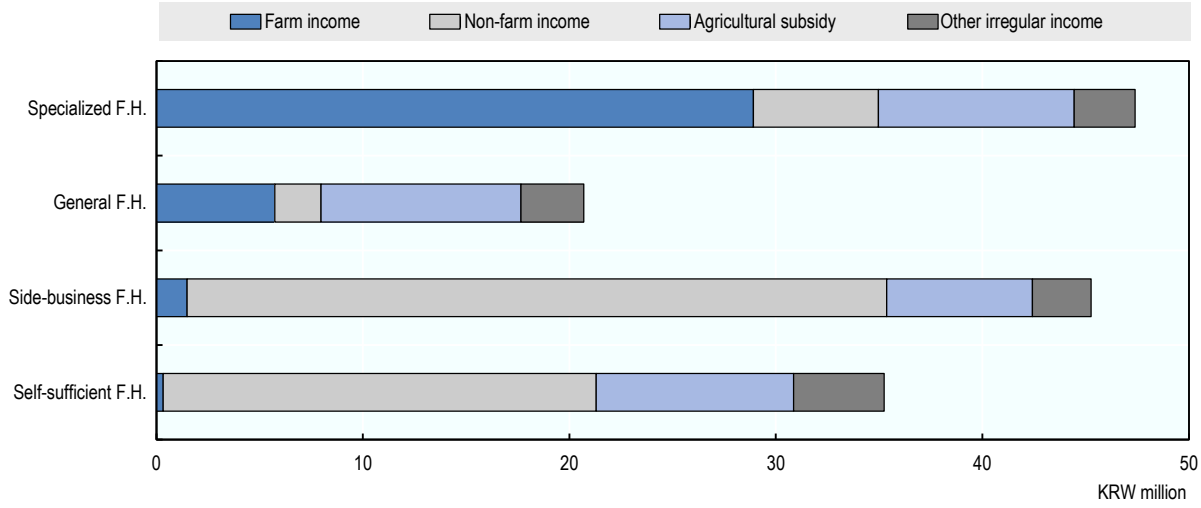
Although wages earned outside of agriculture are the most important source of non-farm income, transfer income has increased its significance as Korea introduced major direct payment systems from the early 2000s. Agricultural subsidies accounted for 20% of the income of specialised farm households and 47% for general farm households in 2014 (Figure 2.11).[3] The share was 16% and 27% for side-business and self-sufficient farm households, respectively. Other types of transfer income such as payments from the social security system including public pension are also important sources of income for most farm households, in particular for general farm households.

Despite a real increase in the level of farm household income, the disparity between urban and farm household income has increased over time. The level of farm household income relative to urban household income declined from 96% in 1995 to 64% in 2015 (KOSTAT, 2016c). However, the income of specialised farm households is higher than other types of farm household, maintaining their relative level of income at 82% of urban households in 2014. The largest income gap with urban households can be found for small-scale producers who depend on farm income (general farm households). Their household income is only 34% of urban households.

Figure 2.11. Composition of farm household income by farm household type in Korea, 2016



Source: KOSTAT (2016b).

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The widening income gap between urban and farm households is a major concern for policy makers in Korea. Real farm income has been declining since the late 2000s, as the growth in farm expenses exceeds that of farm receipts. While the growth in non-farm income led to an overall increase in real farm household income, average farm household income is falling behind urban households. In particular, small-scale aged farmers find it difficult to increase non-farm income as off-farm employment opportunity is limited. In this situation, agricultural subsidies linked to agricultural production have a limited capacity to address income disparity as small size farms with income problem receive less subsidy.

Korea's low-income problem is concentrated in the elderly population. The relative poverty rate of the country's over-65 age group was 49.6% in 2013, which is almost four times higher than the OECD average of 12.6%. Their absolute poverty rate – defined as the share of persons with an income below the minimum cost of living – was 30% in 2014. The high elderly poverty rate reflects both the decline in family support and the weakness of other private and public sources of old-age income support (OECD, 2016a). The poverty situation is more serious in rural areas, where the ageing of the population is much more advanced than in urban areas. The Korea Welfare Panel Survey shows that the poverty rate of urban areas was 13.4% while that of rural areas was 27.9% in 2015.[4]

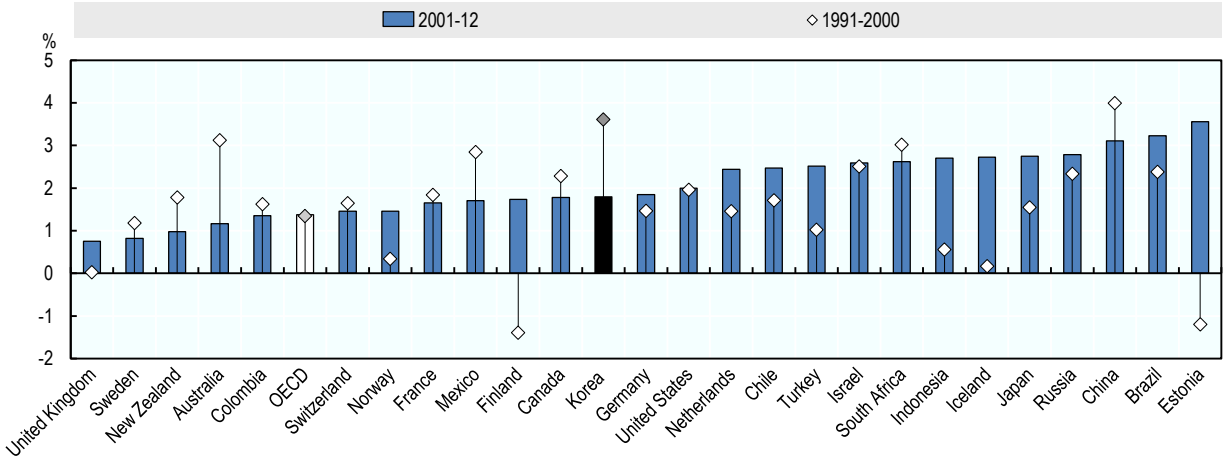
2.4. Productivity and competitiveness of the Korean agro-food sector

Productivity performance in primary agriculture

Total factor productivity (TFP) – the ratio of total output quantity divided by the total input quantity in a given sector – is a standard measure of productivity. According to the US Department of Agriculture, the TFP growth in primary agriculture in Korea has been historically higher than the OECD average (Figure 2.12). Although the TFP growth in Korea was one of the highest among OECD countries in the 1990s, it slowed from 3.6% in 1991-2000 to 1.8% in 2001-12.

Figure 2.12. Agricultural Total Factor Productivity growth, 1991-2000 and 2001-2012

Annual growth rates



Note: The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.
Source: United States Department of Agriculture (2015), Agricultural Productivity Database, Economic Research Service.

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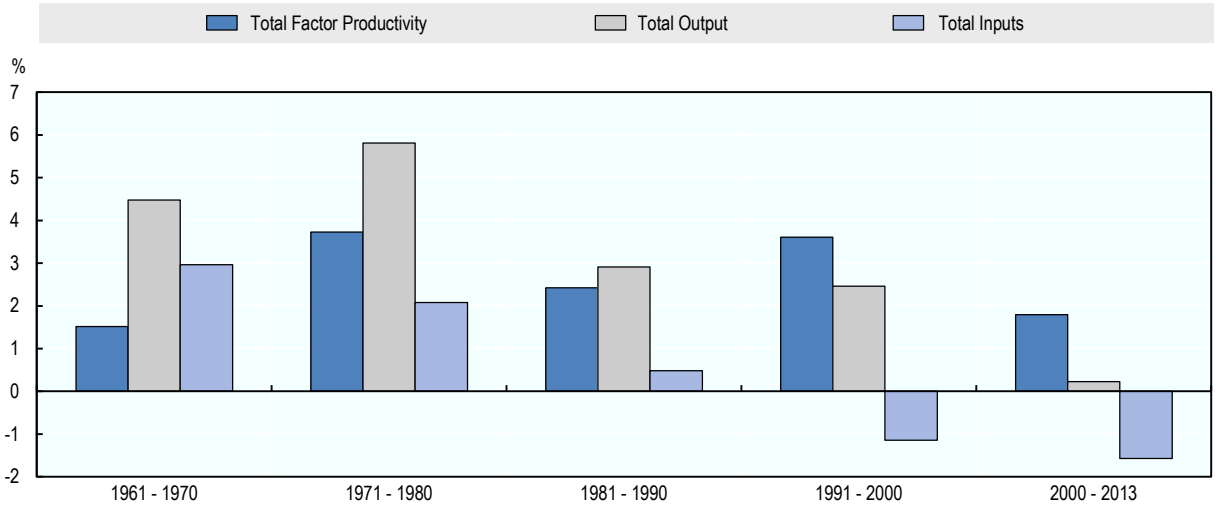
The decomposition of TFP growth into total output and input growth in different time periods shows the dynamics of productivity growth (Figure 2.13). The growth of output was the highest in the 1970s but slowed down to nearly zero in recent years. In the last two decades, productivity growth has been driven mainly by declining input use, in particular labour input. The trend of growth in Korea's real agricultural labour productivity showed an annual growth rate of 6.0% in the 1970s and peaked in the 1980s at 6.6%. However, the growth rate dropped to 3.5% in the 1990s and has been stagnant at 0.6% since the 2000s (KREI, 2015). Animal and feed inputs have grown and the fertiliser and land inputs declined, reflecting Korea's structural change from crop to livestock production.

Figure 2.13. Decomposition of Total Factor Productivity growth in Korea, 1961 to 2013



Source: United States Department of Agriculture (2015), Agricultural Productivity Database, Economic Research Service.

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Box 2.1. Dynamics of productivity growth in the Korean rice sector

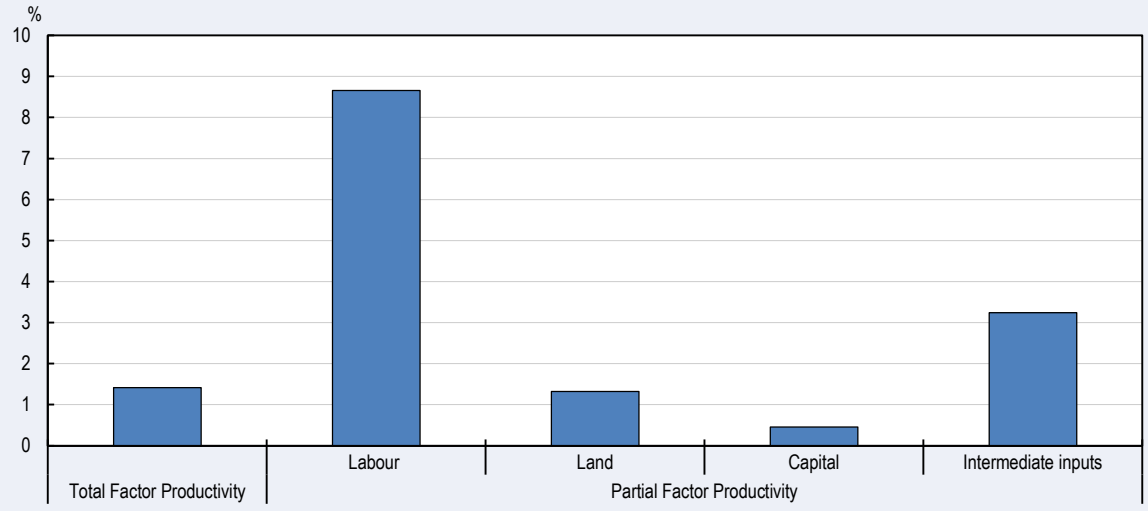
The productivity growth in agricultural sector is driven by farm-level innovation (including farm management practices) and changes in sectorial structure. Measuring productivity at the farm level could identify the channels through which changes in productivity at farm level are translated into productivity growth at sector level (Kimura and Sauer, 2015). Through co-operation with the OECD network for farm-level analysis, KREI used a Farm Production Cost Survey to measure the total factor productivity of rice production between 2003 and 2015. The non-parametric index method is applied to measure TFP both at sector and farm level (see Box 1 in Kimura and Sauer, 2015).

The measurement of the sector-level productivity shows that the TFP of the Korean rice sector grew at 1.4% annually in 2003-15 on average (Figure 2.14). As labour input in the rice sector declined by 4.1% annually in this period, the growth rate of labour productivity was the highest among the single factor productivity indicators, at 8.7%. Meanwhile, capital grew at the highest rate among the inputs, reaching an annual growth rate of 4.1% and leading to lower growth rate of capital productivity compared to other partial factor productivity indicators. The productivity growth of the Korean rice sector is largely driven by improvements in labour productivity.

The measurement of productivity at the farm level sheds light on the dynamics of productivity growth in the Korean rice sector. While unweighted average farm level productivity grew at 2.4% annually in 2003-15, market share weighted average TFP grew at 4.4% annually (Figure 2.15). This means that the farms that have high market shares achieved a higher productivity growth. Indeed, the average productivity growth by three farm size class (the largest and the smallest 25% of farms and the remaining middle size farms) shows that the largest 25% of farms achieved by far the largest productivity growth. The productivity gap between the smallest 25% and the largest 25% of farms increased from 3.0 to 3.9 times between 2003 and15. The analysis indicates that the productivity growth of a small number of large-size farms is driving the TFP growth of the Korean rice sector.

Figure 2.14. Sector level TFP growth in the Korean rice sector, 2003 to 2015

Average annual growth rates



Source: KREI based on Rice Production Cost Survey.

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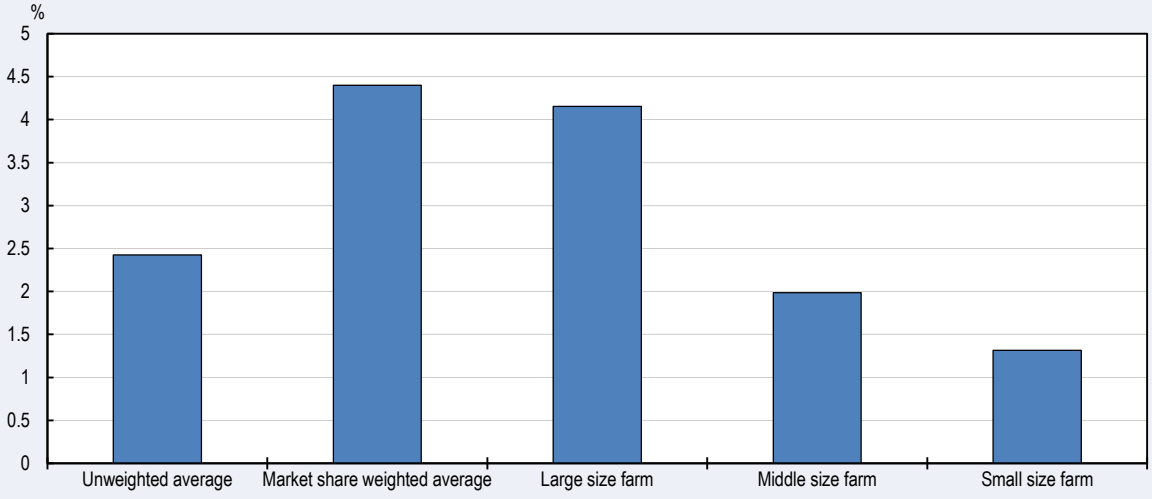
Figure 2.15. Farm level TFP growth in the Korean rice sector, 2003 to 2015

Average annual growth rates



Source: KREI based on Rice Production Cost Survey.

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The sector-level productivity could be decomposed to productivity improvement at the farm level and resources reallocation to more productive farms. Olley and Pakes (1996) developed a decomposition method that can show the extent to which resource allocation across farms contributes to the sector-level TFP. In the case of the Korean rice sector, the productivity gain from the resource allocation to sector-level productivity increased from 59% in 2003-05 to 100% in 2013-15. This means that the sector-level productivity in 2013-15 is twice higher the

case where resource allocation is random between farms with different productivity levels. The increased contribution of resource allocation indicates that more productive farms increased their market share. The statistics shows the concentration of production to large-size farms, which have been expanding their operational size (Table 2.7). The share of rice production by the largest 25% of farms increased from 60% to 69% in 2003-15, while the market share of small and middle-size farms declined over time.

Table 2.7. Evolution of average farm size and market share in the Korean rice sector

	Average size (ha)				Market share (%)			
	2003	2007	2011	2015	2003	2007	2011	2015
Small size farm	0.3	0.3	0.3	0.3	7	6	6	5
Middle size farm	0.8	0.7	0.7	0.8	34	32	31	26
Large size farm	2.6	2.7	2.7	4.2	60	61	62	69

Source: KREI based on Rice Production Cost Survey.

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However, this decomposition is static and cross-sectional and does not take into account the effect of farm entry and exit. Melitz and Polanec (2012) extended the static decomposition proposed by Olley-Pakes to allow for entry and exit, which is called dynamic Olley-Pakes decomposition. The application of this method indicates that on average 76% of productivity growth in the rice sector in 2003-15 can be attributed to the resource allocation effect to more productive farms, while within-farm productivity growth accounts for 12%, and entry and exit also for 12%, of the sector-level productivity growth on average.

The analysis indicates that future productivity gains in the rice sector come from further concentration of land to large-size farms and the improvement of their productivity. The productivity of small and middle-size farms that account for a majority of the rice farm population is low, but efforts to improve their productivity contribute less to sector-level productivity growth as their market shares are shrinking. In other words, the low productivity of small and medium-size farms is not a major constraint to productivity growth of the sector. Policies should rather focus on improving the productivity of the large-size rice farms through providing more tailored support that meets their needs, such as technical advisory and risk management.

Competitiveness of the food manufacturing industry

The food manufacturing industry achieved a remarkable growth in the last decade in Korea. Indeed, the growth rate of production, employment and exports in 2005-14 exceeded most of the benchmark OECD countries (Table 2.8). However, the absolute size of the food industry is still small and exports are limited. The share of food industry in the manufacturing sector was 5.4% in turnover and 6.7% in employment, which is the lowest among the benchmark OECD countries. The growth rate of labour productivity in 2005-14 was lower than most of the benchmarking countries, including EU28 and the United States.

Table 2.8. Performance of food manufacturing industry in selected OECD countries, 2014

	Turnover			Export		Employees			Labour productivity	
	value (billion USD)	annual growth[1] (%)	share in manufacture (%)	value (billion USD)	annual growth[1] (%)	value (thousand)	annual growth[1] (%)	share in manufacture (%)	value (thousand USD per employee)	annual growth[1] (%)
Korea	76	4.1	5.4	4	5.6	195	2.4	6.7	357	1.6
Japan	254	0.0	8.8	3	-1.6	1 139	-0.4	15.4	216	-0.7
United States	899	2.2	15.3	96	1.8	1596	0	14	517	2.2
Germany	320	2.2	9.5	72	-1.0	855	0.2	11.8	350	2.1
France	246	-1.2	21.2	57	-3.6	619	-0.2	20.6	375	3.2
Italy	172	-1.4	14.9	42	-1.6	427	-0.5	11.7	357	-1.0
United Kingdom	160	0.0	18.7	28	-2.3	..	..	15.1	..	..
Netherlands	122	1.0	20.8	79	0.0	126	-0.1	18.8	889	2.6
EU28	1 460	1.0	15.4	125	0.0	4 478	-0.5	15	305	2.6

Note: 1. Annual % change over 2005-14.
Source: KOSTAT (2017b); Ministry of Economy, Trade and Industry of Japan (2017); Census Bureau for United States (2015); Eurostat (2017); and UN Comtrade (2015).

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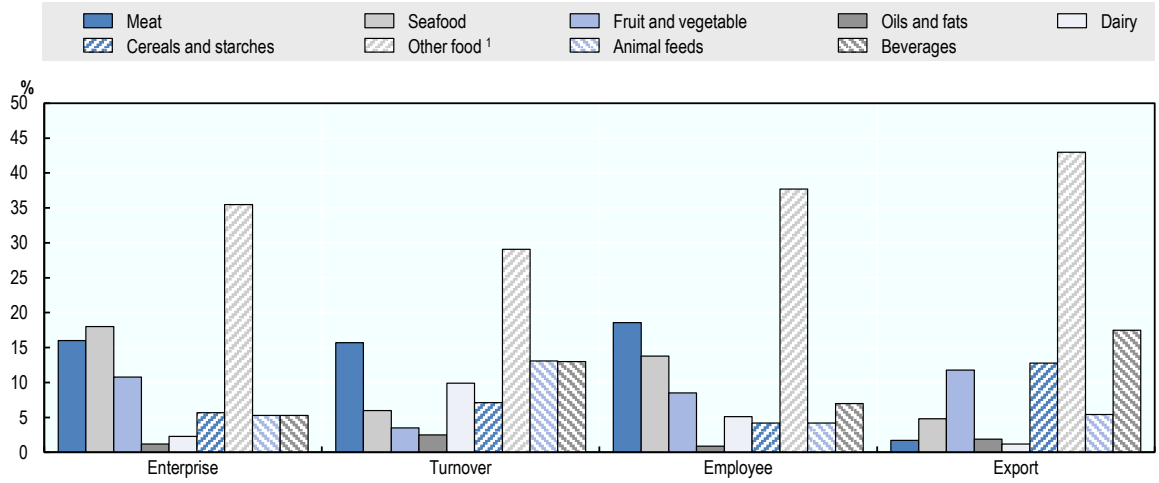
The competitiveness of Korean food manufacturing and its sub-sectors with its major competitors is assessed via the analytical framework developed in Wijnands et al. (2007) and Wijnands et al. (2015). The indicators selected to quantify competitiveness includes two trade-related indicators (market shares on the world market and trade specialisation) and three economic performance indicators (annual growth rates of real turnover, relative growth rate in total manufacturing and labour productivity growth). These indicators capture competition on the world market as well as competition for means of production on the domestic market. The assessment of overall competitiveness is based on the average of five indicators. The benchmark countries and regions comprise Japan, the United States, Germany, France, Italy, the United Kingdom, the Netherlands and EU28.

The overall competitiveness of the Korean food manufacturing sector is assessed slightly above the average, while the United States scored the highest (Figure 2.17.A). While Korea scored the highest for the growth rate of real turnover, its growth performance relative to the manufacturing industry is poor as the other manufacturing sectors grew faster. Although the world market share of Korean food products increased, the comparative advantage of the food manufacturing industry declined at the same time. Although food manufacturing is growing more rapidly than for other countries, the comparative advantage of the sector in the world market declined and the relative growth performance within the domestic manufacturing sector is low. The labour productivity growth of the sector is below the average.

Within the food manufacturing industry, “other food” (rice cakes, bread, snacks, noodles, sugar, tea, coffee and spices) accounts for the largest shares (Figure 2.16). The beverage industry has relatively higher shares in turnover and export, but low shares in enterprises and employment, indicating the concentration in large enterprises. The “other food” and “beverages” industries accounted for 60% of Korea’s value of food exports in 2014 and 40% of the turnover in the food manufacturing industry. The meat industry generates greater employment than the beverage industry but is domestically oriented and exports are very low.

Figure 2.16. Composition of food manufacturing industry in Korea, 2014

Share of food manufacturing industry



Note: 1. "Other food" includes rice cakes, bread, snacks, noodles, sugar, tea, coffee and spices.
Source: KOSTAT (2017b), Mining and Manufacturing survey; UN Comtrade (2015).

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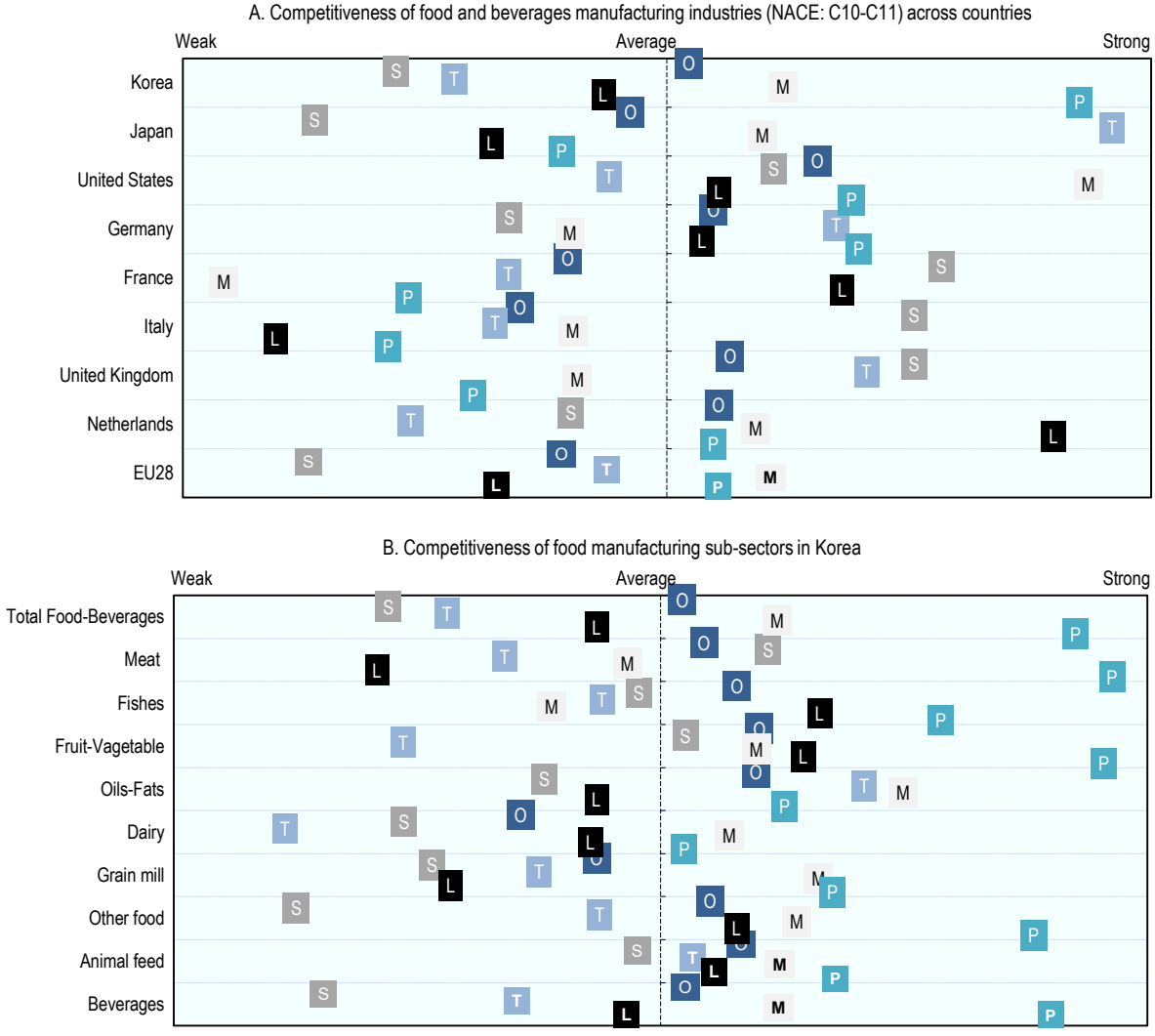
The assessment of the competitiveness of nine sub-sectors of Korea's food manufacturing industry shows the strongest growth in real turnover in the meat, fruits and vegetables, beverage and other food industries in comparison with the benchmark countries, while the relative growth performance of the dairy industry is the weakest (Figure 2.17.B). The meat, and fruit and vegetable industries are the only ones where the relative growth performance within the domestic manufacturing industry is above the average of benchmark countries. On the other hand, the relative growth performance of the "other food" and beverage industries is the weakest among the benchmarking countries despite the higher growth rate of these sectors.

On the trade-related indicators, the relative increase in world market share was the largest in the oil and fat industry, followed by grain mill and other food industries. The increase in market share in meat and fish products was below average. The loss of comparative advantage of dairy and fruits and vegetables was particularly large as imports of these products increased over time. The relative performance of labour productivity growth was the strongest in fish, fruits and vegetable, other food and animal feed industries, whose performance was above the average of benchmark countries. The performances in labour productivity growth in the remaining five sub-sectors of food manufacturing industry were below average. In particular, the productivity performance of the meat and grain mill industries was the worst.

Overall, the average score of five indicators shows that the fruits and vegetables, oil and fats, and fish industries are the most competitive food industries in Korea, although these sectors do not necessarily have large shares in the food industry. On the other hand, the dairy and grain mill industries are found to be the weakest as they are losing comparative advantage and suffering from lower labour productivity growth.

Figure 2.17. Competitiveness of the food manufacturing industries in Korea



Note: The location of each indicator is based on the Z-score that compares the values for individual sub-industries to the overall average. Methodology in Wijnands et al. (2015) is applied to derive the z-scores. EU28 is not included in calculating mean and standard deviation.
Legend:
O: Overall competitiveness;
S: Annual growth of the share of turnover within whole manufacturing industry, 2005-14;
T: Difference in regional trade agreement indicator between 2014 and 2005 (value in 2014 minus the value in 2005);
M: Difference in world market share between 2014 and 2005 (value in 2014 minus the value in 2005);
L: Annual growth rate of labour productivity (real turnover/employee), 2005-14;
P: Annual growth rate of real turnover value, 2005-14.
Source: KOSTAT (2017b), Mining and Manufacturing survey; UN Comtrade (2015).

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2.5. Sustainability performance of Korean agriculture

Concern has been growing about the sustainability of Korean agriculture due to the potentially negative impacts of agricultural production on soil and water quality, and the agricultural ecosystem. An ecosystem under agricultural management which is connected to other ecosystems is greatly affected by non-agricultural pollution sources as well, and the impacts of climate change on agricultural production is also a rising concern (OECD, 2001).

Korean agriculture achieved a substantial improvement in total factor productivity during the past three decades, despite a persistent decrease in the agricultural labour force and farm land. Meanwhile, the cost shares of intermediate inputs and capital continue to increase. The productivity growth of Korean agriculture is led by an increase in intermediate inputs and capital while saving labour and land inputs. Among the intermediate inputs such as seeds, pesticides, fertilisers and animal feeds, the share of animal feeds dramatically increased owing to the growth of livestock industries (Kwon et al., 2015).

With a growing interest in the sustainability performance of agriculture, the Korean government launched the Environment-friendly Agricultural Development Plan in 2001 (MAFRA, 2011). The plan has been updated and revised every five years. Despite government-driven programmes towards enhancing sustainability, not every sustainability indicator shows a significant improvement. Uses of pesticides and fertilisers declined substantially during the period, 1990-2014, but the balances of nitrogen and phosphorous are still high, reflecting the structural change from crops to the livestock sector (Table 2.9)

Table 2.9. Selected Agri-environmental indicators of Korea, 1990 to 2014

	1990-92 average	2002-04 average	2012-14 average	Annual % change over 1990-92 to 1998-2000	Annual % change over 2002-04 to 2012-14
Production [1]					
Index of agricultural production	82.0	99.0	102.2	1.6	0.3
Index of crop production	91.3	97.7	92.6	0.6	-0.5
Index of livestock production	67.6	101.7	116.4	3.5	1.4
Land					
Agricultural land area (thousand ha)	2 159	1 905	1 768	-1.0	-0.7
Agricultural land area (% of land area)	22.4	19.7	18.1	-1.1	-0.8
Agricultural land use (in %)					
Share of arable in agricultural land area	89.2	87.3	84.7	-0.2	-0.3
Share of permanent cropland in agricultural land area	7.6	9.8	12.0	2.1	2.0
Share of permanent pasture in agricultural land area	3.2	3.0	3.3	-0.5	1.0
Fertiliser and pesticide use					
Fertiliser use (thousand tonnes) [2]	951	705	461	-2.5	-4.2
Pesticide use (tonnes)	26.4	25.2	18.6	-0.4	-3.0
Nitrogen balance (kg per ha) [3]	213.1	240.4	249	1.0	-1.1
Phosphorous balance (kg per ha) [4]	47.4	48.4	47	0.2	-1.2
Water					
Total agricultural water withdrawals (million m^3) [5,6]	14 700	16 099	13 555	0.7	-1.5
Irrigated area (thousand ha) [7,8]	984	829	777	-1.3	-1.0
Energy					
Direct on-farm energy consumption (thousand tonnes oil equivalent) [9]	1 852	2 636	1 808	3.0	-6.7
Share of agriculture energy consumption (% of total national energy use) [9]	2.5	1.9	1.2	-2.3	-8.8
Air and climate change					
Agricultural GHG emissions (million tons of CO_2 equivalent) [10]	21.9	20.9	21.7	-0.4	0.8
Agricultural GHG emissions (% of total national emissions) [10]	7.7	4.3	3.3	-4.7	-5.2

Notes: 1. 2004-06=100.
2. In nitrogen, phosphate and potash nutrients; Data source: Statistics Korea.
3. Nitrogen balance per ha of agricultural land. Number for 2002-04 is the average of 2000-02.
4. Phosphorous balance per ha of agricultural land. Number for 2002-04 is the average of 2000-02.
5. The number for 1990-92 is that of 1990; the number for 2002-04 is that of 2002; the number for 2012-14 is that of 2013.
6. The number for 2012-14 is retrieved from the Ministry of Land, Infrastructure and Transport (2016); all other data are from FAOSTAT.
7. The number for 1990-92 is that of 1990; the number for 2012-14 is that of 2013.
8. The number for 2002-04 is retrieved from the Korea Rural Community Corporation (2005); the number for 2012-14 is that of 2013 and retrieved from the Korea Rural Community Corporation (2014).
9. The number for 2012-14 is the average of 2008-10.
10. Data are retrieved from the Greenhouse Gas Inventory & Research Centre (2016).
Source: FAO (2017), *FAOSTAT* (database), http://faostat.fao.org; OECD (2017b), *Agri-Environmental Indicator Database,* http://stats.oecd.org; Greenhouse Gas Inventory and Research Centre (2016); Korea Rural Community Corporation (2005, 2014); KOSTAT (2017a), *National key indicators,* http://www.index.go.kr.

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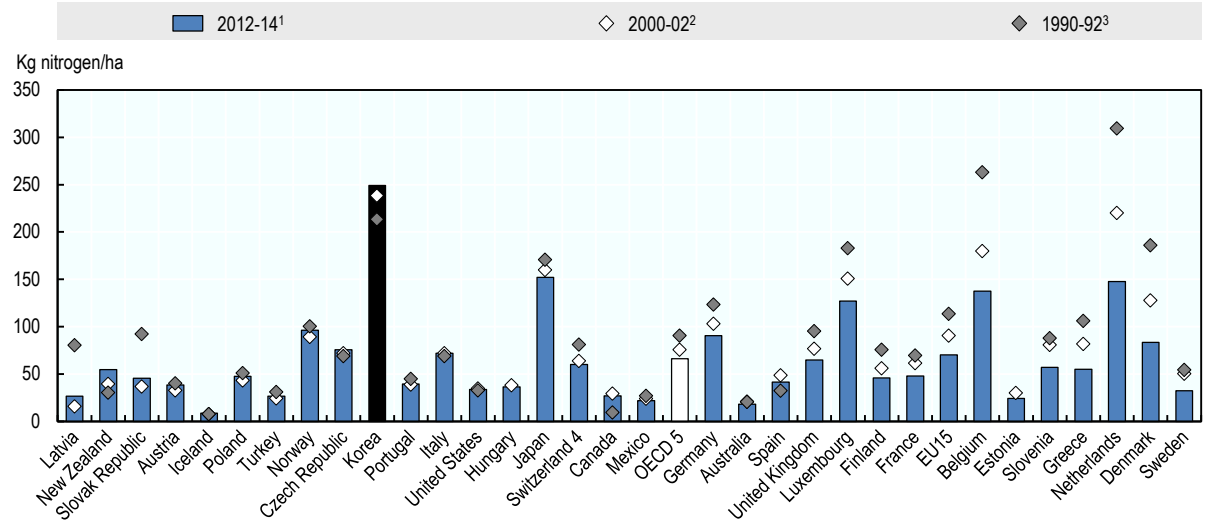
Nutrient surplus

Korea currently shows the highest nitrogen balance among all OECD countries (Figure 2.18). The average nitrogen balance per ha in Korea increased from 213.1 kg/ha in 1990-92 to 249 kg/ha by 2012-14. Most OECD countries succeeded in reducing their nitrogen balances over time. For example, despite the growth in livestock production, the nitrogen balance of the Netherlands fell to 148 kg/ha in 2012-14 from the 1990-92 level of 309 kg/ha owing to the policies of manure quota system and manure application limits (Box 3.3). Before 1990, the increase in nitrogen balance in Korea was mainly driven by the increasing use of chemical fertilisers. However, from 1990, livestock manure became the main source of the increasing balance indicator (Lee et al., 2000). The reduction in fertiliser subsidies in the 1990s and 2000s also contributed to the reduced use of fertilisers (Lee, 2003).

Figure 2.18. Nitrogen balance in OECD countries, 1990-92, 2000-02 and 2012-14

Balance (surplus or deficit) expressed as kg nitrogen per ha of total agricultural land



Notes: 1. Data for 2012-14 average refer to: 2011-13 average for Australia, Germany, Japan, Mexico, Sweden, Switzerland and the United States.
2. Data for 2000-02 average refer to: 2004-06 average for Estonia.
3. Data for 1990-92 average refer to: 1990 for the United Kingdom, 1992-94 average for Slovenia, and 1995-97 average for Portugal, while for Estonia and Hungary data are not available.
4. For Switzerland, total agricultural area includes summer grazing.
5. The OECD total excludes Chile, Estonia, Hungary, Israel, Latvia and Lithuania.
6. Countries are ranked according to average annual percentage change 2000-02 to 2012-14.
Source: OECD (2017b), Agri-environmental indicator database, http://stats.oecd.org/.

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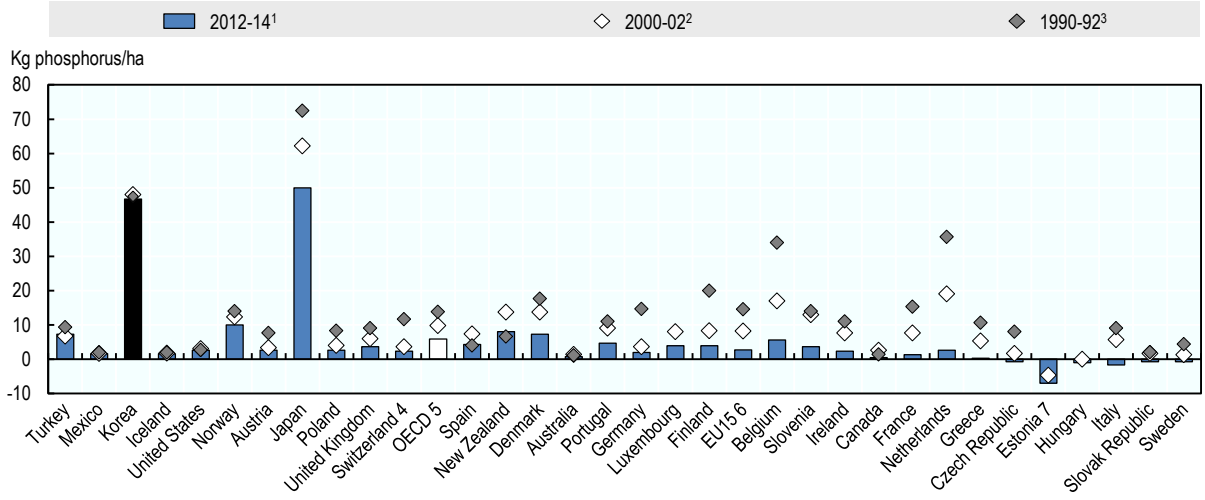
Relatively little change over time in average phosphorous balance is observed (Figure 2.19). However, Korea's balance indicator is the second highest among OECD countries. While most countries reduced the phosphorous balance, that in Korea has remained at the same level since 1990. Kim et al. (2015b) show a substantial regional variation in per ha N and P balances (Table 2.10). Both N and P balances are the highest in Gyeonggi province, which has the country's largest dairy industry and the second largest swine industry. In order to achieve improvements in nitrogen and phosphorous balances,

Kim et al. (2015b) suggested imposing regional nutrient quotas, but no such quantity restriction has yet been implemented.

Figure 2.19. Phosphorus balance in OECD countries, 1990-92, 2000-02 and 2012-14

Balance (surplus or deficit) expressed as kg phosphorus per ha of total agricultural land



Notes: 1. Data for 2012-14 average refer to 2011-13 average for Australia, Germany, Ireland, Japan, Mexico, Sweden, Switzerland and the United States.
2. Data for 2000-02 average refer to 2004-06 average for Estonia.
3. Data for 1990-92 average refer to year 1990 for the United Kingdom, 1992-94 average for Slovenia, 1993-95 average for the Slovak Republic and 1995-97 average for Portugal, while for Estonia, Hungary and Luxembourg data are not available.
4. For Switzerland, total agricultural area includes summer grazing.
5. The OECD total excludes Chile, Estonia, Hungary, Israel, Latvia, Lithuania and Luxembourg.
6. The EU total excludes Luxembourg.
7. For Estonia, the average annual percentage change refers to change in phosphorus deficit.
8. Countries are ranked according to average annual percentage change 2000-02 to 2012-14, except the Czech Republic, Estonia, Hungary, Italy, the Slovak Republic and Sweden for which annual changes were not calculated.
Source: OECD (2017b), Agri-environmental indicator database, http://stats.oecd.org/.

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Table 2.10. Estimated nutrient balance by province in Korea, 2014

Kg/ha

	Nitrogen	Phosphorous	Total
Gyeonggi	242.1	173.0	415.0
Kwangwon	150.1	80.2	230.4
Chungbuk	164.9	92.5	257.4
Chungnam	155.1	80.7	235.8
Chonbuk	169.9	78.1	248.0
Chonnam	107.3	33.9	141.2
Gyeongbuk	144.9	91.0	235.9
Gyeongnam	83.8	48.6	132.3
Jeju	77.4	42.5	119.9

Source: Kim et al. (2015b).

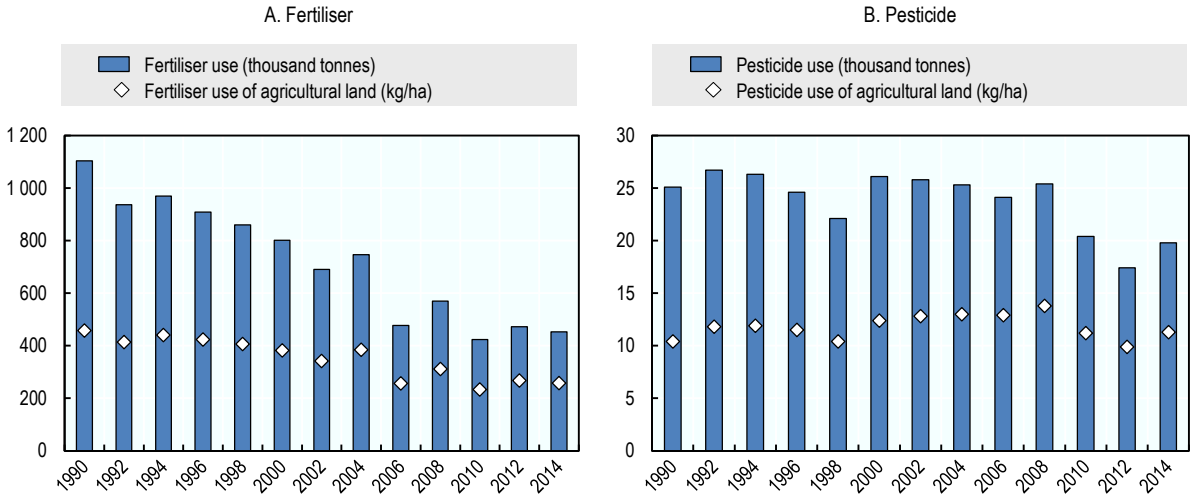
StatLink https://doi.org/10.1787/888933852274

Fertilisers and pesticides

Among the three major types of chemical fertilisers (nitrogen fertilisers, phosphate fertilisers and potash fertilisers), nitrogen fertilisers occupy almost half of the total chemical fertilisers in Korea. Total consumption of chemical fertilisers reached 951 000 tonnes in 1990-92 but declined consistently since then: 705 000 tonnes in 2002-04 and 461 000 tonnes in 2012-14. Per ha use of chemical fertilisers also fell from 407 kg/ha in 1990-92 to 262 kg/ha in 2012-14 (Figure 2.20). The structural change away from crop production as well as the abolishment of the fertiliser subsidy in 2005 contributed to the reduction of fertiliser inputs in Korea.[5]

Annual use of chemical pesticides was 26 000 tonnes in 1990-92 but dropped to 16 000 tonnes in 2012-14. Per hectare use of chemical pesticides also declined slightly, from 11.3 kg/ha in 1990-92 to 10.6 kg/ha in 2012-14. The declining rate of chemical pesticide use was not as high as that of chemical fertiliser use because pest and disease outbreaks occur frequently due to the high temperature and humidity of the monsoon climate. Multiple-crop farming also requires an intensive use of pesticides. Nevertheless, it is anticipated that the use of pesticides will not increase in the future, owing to the increased share of pesticide-free or organic products and more stringent safety regulations on chemical pesticides (Korea Crop Protection Association, 2015). The share of land under certified organic farm management in Korea is still relatively small but has been growing (Figure 2.21).

Figure 2.20. Evolution of fertiliser and pesticide use in Korea, 1990 to 2014



Source: KOSTAT (2017a), National key indicators, http://www.index.go.kr.

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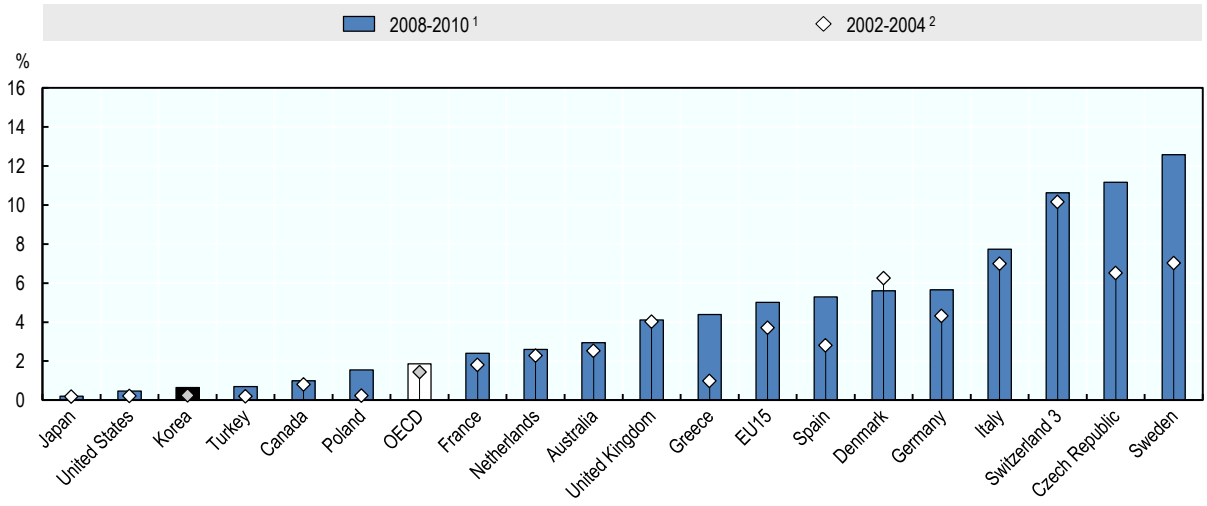
Figure 2.21. Agriculture land area under certified organic farm management in selected OECD countries, 2002-04 and 2008-10

Share of agricultural land area



Notes: Countries are ranked according to 2008-10 averages.
1. Data for the 2008-10 average refer to: 2007-09 average for Canada, Denmark, Korea and Spain, 2007-08 average for Italy, and year 2007 for Greece.
2. Data for 2002-04 average refer to: year 2005 for Japan, 2003-04 average for Korea, 2003-05 average for Poland, and year 2003 for Greece.
3. For Switzerland, organic farming as a share of the Utilised Agriculture Area (ha) includes arable and permanent cropland but excludes summer pasture.
Source: OECD (2013), *OECD Compendium of Agri-environmental Indicators*, http://dx.doi.org/10.1787/9789264186217-en.

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Land conservation

Despite the regulation on the conversion of high quality agricultural lands, decline of the total area of agricultural land has continued with increased demand for non-agricultural lands and public reclamation projects. The total agricultural land area declined by 18% between 1990-92 and 2012-14, reducing the share of agricultural land in total area of land from 22% to 18% in the entire period. In Korea, arable land and permanent cropland occupied 97% of the total agricultural land in 2012-14, while the share of pasture was 3.3%. Korean livestock farming is largely dependent on imported animal feed crops.

Soil quality management contributes to agricultural ecosystem conservation and directly affects crop productivity. Kim et al. (2014b) estimated that the available phosphate in soils exceeded the appropriate levels by 1.3 times for paddy land, 1.4 times for crop field, 2.1 times for permanent cropland, and 2.1 times for greenhouse land. The study also found empirically that the practices of environment-friendly farming contribute to soil quality management by increasing the organic matter content of soils.

Water

In 2007, the total amount of water available for Korea was 130 billion m^3 of which 33.3 billion m^3 was withdrawn (Table 2.11). The agricultural use represented 48% of total

water withdrawal. Total water withdrawal increased persistently because of the increase in water demand caused by economic and population growth and the change in industry structure. The construction of the irrigation system largely contributed to the rapid increase in agricultural water consumption. The irrigation water application rate was 18.2 megalitres per hectare of irrigated land in 2008-10, which was the second highest among OECD countries, next to Japan (OECD, 2013).

Table 2.11. Water withdrawal by usage in Korea, 1965 to 2007

Billion cubic metres

	1965	1980	1994	1998	2003	2007
Total amount of water	**110**	**114**	**127**	**128**	**124**	**130**
Total withdrawal amount of water	5.1	15.3	30.1	33.1	33.7	33.3
Residential water	0.2	1.9	6.2	7.3	7.6	7.5
Industrial water	0.4	0.7	2.6	2.9	2.6	2.1
Agricultural water	4.5	10.2	14.9	15.8	16.0	15.9
Maintenance water requirement	..	2.5	6.4	7.1	7.5	7.8

Source: Ministry of Land, Infrastructure and Transport (2013), *Water vision 2020.*

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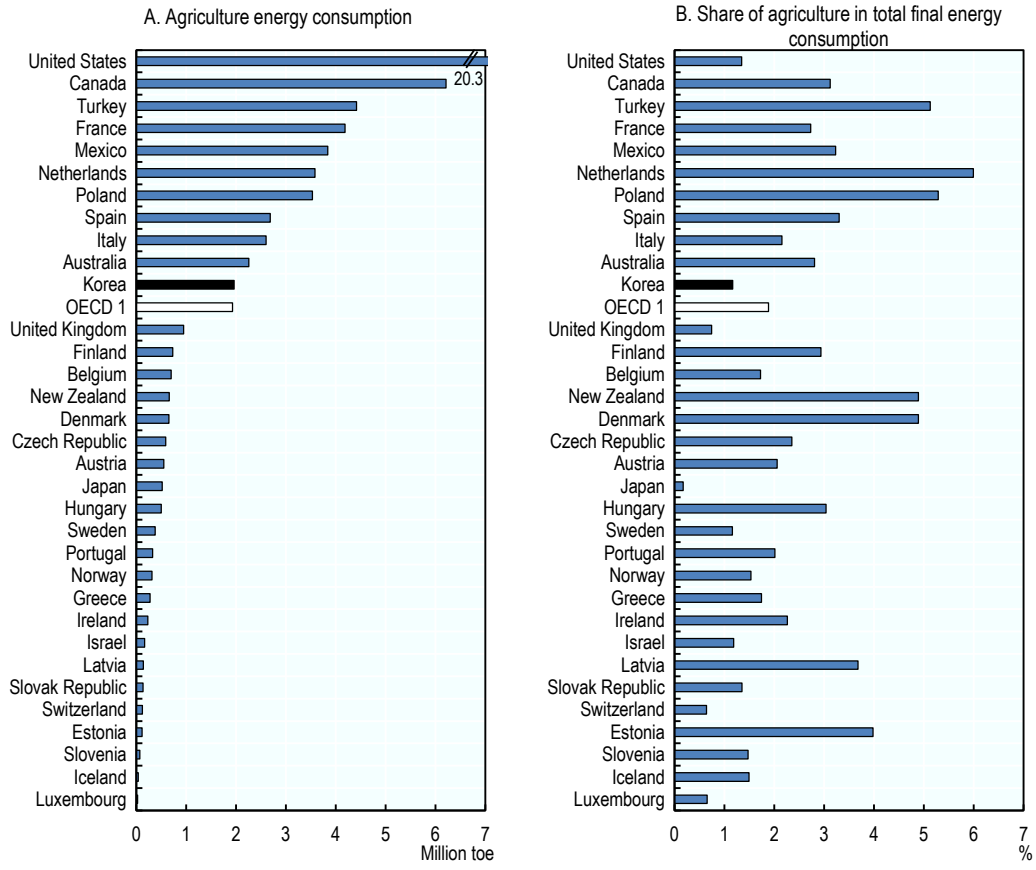
While it is forecast that the agricultural water demand in 2020 will be smaller than the current level, the agricultural sector is still the most water-intensive industry, accounting for almost half of total water withdrawals. In the future, climate change may affect the irrigation and drainage system via an increased frequency of floods and droughts. An increase in temperature may raise both water evaporation and demand for water (FAO, 2016b: 6-7). The importance of securing and managing water resources is being greatly emphasised in Korea's agricultural policy priorities (Kim et al., 2014b).

In 2012, the total groundwater use was 3.7km^3 of which 2km^3 was used for agricultural purposes. However, Korean rice production is heavily dependent on surface water, and the development of irrigation facilities has been concentrated in rice production areas. In 2013, 80.6% of total rice paddy area was equipped with an irrigation facility (KRC, 2014). However, the total area of irrigated farmland declined by 22% between 1990-92 and 2012-14 due to the conversion of farmland to non-agricultural use, as well as water scarcity (Kim et al., 2014b).

Energy and greenhouse gas (GHG) emissions

Farm mechanisation and the increase in greenhouse farming have resulted in a substantial increase in agricultural energy use. Energy consumption by Korean farm households in 2012-14 was 1.96 million toe (tonnes oil equivalent), which was above the OECD average and almost four times larger than that of Japanese farm households (Figure 2.22). However, the share of agricultural energy use in total energy use in Korea was smaller than the OECD average, reflecting the smaller share of agriculture in GDP.

Figure 2.22. Agriculture energy consumption in selected OECD countries, 2012-14



Note: 1. The OECD average excludes Chile, Germany and Lithuania. For Chile and Germany, Agriculture consumption data are not available.
The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.
Source: OECD (2017b), *Agri-Environmental Indicator Database*, http://stats.oecd.org based on the IEA World Energy Balances Database (2016).

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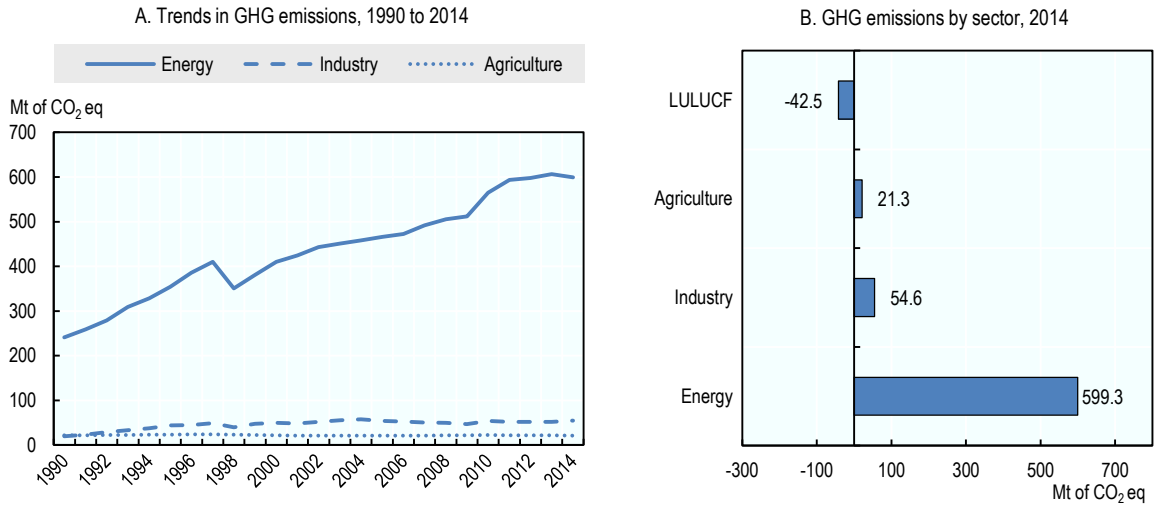
Korea undertook several initiatives to target energy saving and achieve energy balance in rural areas. In 2012, an agricultural carbon offset system was introduced. Under the system, carbon credits (carbon reduction certifications) are given to farm households which reduce carbon emission by recycling waste heat and using biogas plants (Kwon, 2012). The system aims at conserving energy and promoting environmental conservation in rural areas. However, taxes on petroleum products are exempted when they are purchased by registered farmers or agricultural corporations for use with certain farm machines. Farmers also benefit from the reduced price of the electricity used for pumping, drainage and other agricultural purposes. Those two agricultural energy subsidies may provide disincentives for energy saving in the agricultural sector (Jeong, 2013).

In 2014, GHG emissions from the agricultural (and fishery) sector were 21.3 million tCO_2, representing 3.1% of national emissions (Greenhouse Gas Inventory & Research Centre, 2016). Agricultural emissions come mainly from non-energy sources: emissions from rice

cultivation, soils and manure management, and livestock enteric fermentation. For the past 20 years, the amount of non-energy source agricultural emissions did not change significantly although there was a change in their composition: the share of emissions from livestock enteric fermentation increased while that of methane emissions from paddy rice decreased. However, non-agricultural energy source emissions increased at a faster rate. As a result, the share of the agricultural and fishery sector in total greenhouse gas emissions has been declining (Figure 2.23). GHG emissions from agricultural production are mostly non-energy emissions. Emissions from rice production have been declining because of the decline in the rice cultivation area but the share of emissions from the livestock sector increased (Table 2.12).

Figure 2.23. Greenhouse gas emissions in Korea

Million tonnes of CO_2 equivalent



Note: LULUCF refers to land use, land-use change and forestry, and includes both carbon emissions and sinks, and the value above represents the net absorbed amount of GHG emissions.
Source: Greenhouse Gas Inventory & Research Centre (2016), National greenhouse gas inventory report of Korea.

StatLink https://doi.org/10.1787/888933851590

Table 2.12. Greenhouse gas emissions in the Korean agricultural sector, 1990 to 2014

Million tonnes of CO_2 equivalent

	1990	1995	2000	2005	2010	2011	2012	2013	2014
Enteric fermentation	3.0	4.1	3.4	3.3	4.3	4.2	4.4	4.4	4.2
Manure management	2.9	4.1	3.9	4.1	4.9	4.6	4.7	4.8	4.6
Livestock subtotal	5.8	8.2	7.3	7.4	9.2	8.8	9.1	9.2	8.8
Rice cultivation	10.8	9.4	8.9	8.2	7.5	7.3	7.1	6.9	6.8
Agricultural soils	4.9	5.8	5.6	5.4	5.7	5.3	5.7	5.8	5.6
Field burning of agricultural resides	0.033	0.025	0.029	0.027	0.024	0.022	0.021	0.021	0.021
Crop subtotal	15.8	15.2	14.5	13.7	13.2	12.6	12.8	12.7	12.5
Total	21.6	23.4	21.8	21.1	22.4	21.5	21.9	21.9	21.3

Source: Greenhouse Gas Inventory & Research Centre (2016), 2016 National Greenhouse Gas Inventory Report of Korea.

StatLink https://doi.org/10.1787/888933852312

Resilience to climate change

Agricultural production is highly dependent on climate conditions. Based on the long-term forecasts of Korea's Meteorological Administration, Kwon and Cho (2015) predicted that the country's summer and winter temperatures will increase under most climate change scenarios of the Intergovernmental Panel on Climate Change (IPCC). They forecasted, however, that the future precipitation level will differ markedly by scenario.

The impacts of climate change on agricultural productivity in Korea are not clearly known yet. Crop simulation studies conducted by Korean scientists showed that future changes in climate variables will negatively affect rice yields but will positively affect barley yields (Shim et al., 2011a, 2011b).

For rice, which is the single most important crop in Korea, several econometric studies estimated the impacts of climate variables on rice yields using historical datasets. Those studies, including Cho and Kwon (2014), Cho et al. (2013), and Kwon and Kim (2008), identified climate variables such as average temperature of each season, precipitation, sunshine duration and daily temperature variation affecting rice yields, and predicted that future rice production may decrease under climate change. Moreover, Cho and Kwon's (2014) econometric model estimating the impacts of climate variables on productivity and variability of rice production simultaneously showed that future change in climate variables will increase variability, i.e. the risk to rice production under most climate change scenarios. Future possible loss in irrigation functions under climate change may also negatively affect rice production, which is heavily dependent on irrigation water.

Although climate change is forecasted to affect rice productivity negatively, it is still uncertain whether the overall economic value of climate change is positive or negative. Kwon and Cho (2015), using a city/town-level dataset, econometrically identified the determinants of crop choice in each city/town. Their estimation results implied that the future change in climate variables will reduce the area of rice paddy but raise the cultivation areas of vegetables and fruits in many regions. Because per capita consumption of rice is declining and per unit value-added of vegetables and fruits is higher than that of rice, it may be possible that producer's adaptation response to climate change optimally increases the total agricultural value-added by altering product mix. In contrast, if the productivity loss in the rice industry is very high, then the overall economic impact will be negative despite adapting the choice of crop mix.

2.6. Challenges for the future

Remarkable economic growth in Korea in the last four decades has been led by export-oriented industrialisation. In this process, the significance of agriculture in value-added, employment and trade has diminished rapidly. The sector has been under pressure to meet changing domestic demands and to improve its productivity in a very limited time. At the same time, the policy environment has changed to increase the exposure of producers to international competition.

Korean agriculture has adjusted its structure, driven by a rapid change in the structure of food demand. The westernisation of the Korean diet, which is associated with income growth, reduced the per capita rice consumption and increased the demand for livestock products. While the share of rice in agricultural production value declined from 37% to 17% between 1970 and 2015, the share of livestock increased from 15% to 43% during the same period. The operational size of livestock production expanded rapidly and reached an equivalent size with EU counties.

Korea is one of the most land-scarce countries of the OECD. In fact, arable land per capita (0.03 ha) is the smallest among the group, and the land intensive crop sector thereby has a comparative disadvantage. Moreover, the fragmented land structure makes consolidation of cropland particularly challenging. The data shows that the concentration of land-use to large-scale farms has been slow. While more than 65% of Korean farms are less than 1 ha in size, the share of land cultivated by more than 10 ha of land remained 14% in 2015, while the share of land used by this size class of farm increased to 48% in Japan.

Korea achieved a higher productivity growth in primary agriculture than the OECD average for the last five decades, mainly driven by a declining labour input through rural to urban migration and farm mechanisation. The resource reallocation to more productive farms and to growing sectors such as livestock and horticulture also contributed to the overall productivity growth. For example, the productivity growth in the rice sector has largely been led by the concentration of land to a small number of large size farms with high productivity levels. Farm structure in Korea is expected to be further polarised to large-scale commercial producers and small-scale subsistent producers. Policies should facilitate the structural change and focus more on improving the productivity of large size commercial farms through providing more tailored support that meets their needs, such as technical advisory and risk management.

Rapid industrialisation in urban areas and the migration of the young population from rural to urban areas have led to rural areas being economically left behind. The expanding gap in income between farm and urban households is a major concern for Korea's policy makers. The average farm household income has declined to 65% of the average urban household income, which is low when compared to almost all other OECD countries. Real farm income has been declining since the late 2000s as the growth in farm expenses exceeded that of farm receipts. While the growth in non-farm income led to an overall increase in real farm household income, off-farm employment opportunities are also limited in rural areas, in particular for the aged population. Under these circumstances, agriculture-sector-specific policy has a limited capacity to solve the low-income problem of small-scale producers. Broader rural development policy and general social security policy should play a greater role in addressing the income disparity issues between urban and farm households.

The future demographic change and slowdown in economic growth will have a significant influence on Korean agriculture through changing the food demand structure and increasing the cost of labour. The domestic food market is unlikely to expand due to the declining population and ageing. Per capita consumption of rice nearly halved in just 25 years, and rice consumption is likely to decline even further. Given the limited expansion of domestic food demand, future growth opportunities for Korean agriculture are increasingly dependent on the supply of value-added products to both domestic and export markets. Korean agriculture has the potential to be competitive in exporting the niche agricultural products and processed foods that reflect the country's rich and unique food culture. To assure the long-term health of Korea's food and agriculture system, it is critical to increase its capacity to respond to market demands.

Korea's food industry has shown remarkable growth in the last decade. Promoting the food manufacturing industry would exploit the comparative advantage of Korea to export more capital and knowledge-intensive food products. The food manufacturing industry also has the potential to create employment in rural areas. However, an assessment of its competitiveness against major competitors shows that, while it grew faster, its growth performance was in most cases worse in terms of labour productivity as well as in

comparison with overall manufacturing sector. Further restructuring is necessary to improve the food manufacturing industry's competitiveness, for example by establishing a more competitive domestic agricultural sector and a more open agricultural trade regime.

Despite the declining share of primary agriculture in the economy, controlling environmental impacts of agriculture on natural resources is still important as the sector occupies 20% of the country's total land area and accounts for almost half of total water withdrawal. Nitrogen and phosphorus surpluses remain among the highest of OECD member countries. Korea reduced the use of chemical fertilisers and pesticides, but the rapid expansion of intensive livestock production made manure emissions the main agricultural source of water and soil pollution. The increasing share of greenhouse farming is also making farming in Korea more energy dependent. Contamination and pollution of soil and water resources raises uncertainty about future productivity growth, as does climate change, which is expected to raise temperatures, the spread of pests and disease, and more frequent and more severe droughts and floods. Promoting the sustainable use of land and water and increasing preparedness to climate change is an important policy agenda to assure long-term growth in agriculture.

Notes

[1] A farm household is defined as one cultivating farm land over 0.1 ha, engage in farming activities including livestock husbandry more than 90 days a year, or having sales of agricultural products exceeding KRW 1 million (approx. USD 1 000).

[2] *A specialised farm household* is defined as a farm household with a farm size larger than 3 ha or with annual sales of more than KRW 20 million (USD 20 000), and whose agricultural income exceeds non-agricultural income. *A general farm household* is defined as a farm household with a farm size between 0.3 -3 ha and annual sales between KRW 2 million (USD 2 000) and KRW 20 million (USD 20 000), and whose agricultural income exceeds non-agricultural income. *Side-business farm households* are those with a farm size 0.3 ha or larger or annual sales more than KRW 2 million (USD 2 000), and whose agricultural income is smaller than non-agricultural income. *Subsistent farm households* are those whose farm size is smaller than 0.3 ha with annual sales of less than KRW 2 million (USD 2 000).

[3] The agricultural subsidy includes only budgetary transfer and does not include a form of market price support.

[4] In the Korea Welfare Panel Survey, an incidence of poverty is defined as a household whose income level is below 50% of median income in the country.

[5] However, ad hoc support for chemical fertiliser was provided to mitigate the impact of high input prices in 2008-09 and 2010-12.

References

Bokusheva, R. and S. Kimura (2016), "Cross-Country Comparison of Farm Size Distribution", *OECD Food, Agriculture and Fisheries Papers*, No. 94, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jlv81sclr35-en.

Census Bureau for United States (2015), *Annual Survey of Manufactures (ASM)*, https://www.census.gov/en.html.

Cho, H. K., E. B. Cho, O. S. Kwon and J. S. Roh (2013), "Climate Variables and Rice Productivity: A Semi-Parametric Analysis Using Panel Regional Data," *Korean Journal of Agricultural Economics*, 54(3): 71-94.

Cho, H. K. and O. S. Kwon (2014), "Climate impacts on rice productivity and variability in Korea," *Korean Journal of Agricultural Economics,* 55(3): 115-140.

Eurostat (2017), *Structural Business Statistics*, http://ec.europa.eu/eurostat/data/database.

FAO (2017), *FAOSTAT database*, FAO Publications, Rome, http://faostat.fao.org/.

FAO (2016a), FAOSTAT (database), Food and Agriculture Organization of the United Nations, http://faostat3.fao.org/home/E.

FAO (2016b), *Climate Change and Food Security: Risk and Responses,* http://www.fao.org/3/a-i5188e.pdf.

FAO (2015a), FAOSTAT (database), Food and Agriculture Organization of the United Nations, http://faostat3.fao.org/home/E.

FAO (2015b), AQUASTAT Main Database, Food and Agriculture Organization of the United Nations.

Greenhouse Gas Inventory and Research Center (2016), *2016 National Greenhouse Gas Inventory Report of Korea*, GIR Research Report.

Jeong, H. G. (2013), "The Status and Problems of Agricultural Electricity Consumption in Korea", Korea Energy Economics Institute.

Kim, K.S., Im, J. B., An, D. H., Kim, S. H., Ahn, B. I., Kim, K. H, Min, S. H., Ha, Y. H., Lee, H. D., Kang, M. J., Kim, M. I., Kim, H. E., Song, S. W., Woo, S. H., Lee, Y. Y., Jung, J. K., Yu, J. Y., Lee, D. K. (2015a), *Food industry linkage structure analysis,* Korea Agro-Fisheries & Trade Corporation, Naju.

Kim, C. G., H. K. Jeong, P. E. Im and T. H. Kim (2015b), *Directions for Introducing Total Maximum Nutrient Loading System of Cultivated Land*, p. 91, Korean Rural Economic Institute Research Report.

Kim, Y. L., Jeong, E. M., Choi, Y. W., Han, T. N. (2014a), A study on the development strategies of the 6th industry of agriculture by analyzing rural industrial statistics, Korea Rural Economic Institute, Seoul

Kim, C. G., H. K. Jeong, D. H. Moon and Clem Tisdel (2014b), *Establishment of Sustainable Agriculture System in Korea*, Korean Rural Economic Institute Research Report.

Kimura, S. and J. Sauer (2015), "Dynamics of dairy farm productivity growth: Cross-country comparison", *OECD Food, Agriculture and Fisheries Papers*, No. 87, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jrw8ffbzf7l-en.

Korea Agro-Fisheries & Trade Corporation (2016), *Food Statistics 2016.*

Korea Crop Protection Association (2015), *Statistical Yearbook of Pesticide*.

Korea Rural Community Corporation (2014), Statistical Yearbook of Land and Water Development for Agriculture.

Korea Rural Community Corporation (2005), Statistical Yearbook of Land and Water Development for Agriculture.

KOSTAT (2017a), *National key indicators*, Statistics Korea, http://kostat.go.kr/portal/eng/index.action.

KOSTAT (2017b), *Mining and Manufacturing survey*.

KOSTAT (2016a), *Census of Agriculture, Forestry and Fisheries 2015*, Statistics Korea, Daejeon, Korea, http://kosis.kr/statisticsList/statisticsList_01List.jsp?vwcd=MT_ZTITLE&parentId=F.

KOSTAT (2016b), *Farm Household Economic Survey*, Statistics Korea, Daejeon, Korea, http://kosis.kr/statisticsList/statisticsList_01List.jsp?vwcd=MT_ZTITLE&parentId=F#SubCont.

KOSTAT (2016c), *Household Income and Expenditure Survey*, Statistics Korea, Daejeon, Korea, http://kosis.kr/eng/statisticsList/statisticsList_01List.jsp?vwcd=MT_ETITLE&parentId=C#SubCont.

KOSTAT (2012), Population Projections and Summary indicators for Korea. http://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT_1B35001&conn_path=I2&language=en.

KREI (2015), *Agriculture in Korea*, Korea Rural Economic Institute, Naju-shi.

Kwon, J. K. (2012), "Declaration of Energy Independence in Korean Agriculture", RDA Interrobang 85: 1-20.

Kwon, O. S., K. H. Ban and J. W. Yoon (2015), "Constructing KLAM Data and Analyzing Productivity Change of Korean Agriculture," *Korean Journal of Agricultural Economics*, 56(3): 69-103.

Kwon, O. S. and C. G. Kim (2008), "Climate Change and Rice Productivity: Nonparametric and Semiparametric Analysis," *Korean Journal of Agricultural Economics*, 49(5): 45-64.

Kwon, O. S. and C. H. Cho (2015), "Climate Change and Farm Land Use: A Multivariate Fractional Data Analysis," A Paper Presented in the 5th Annual Congress of the East Asian Association of Environmental and Resource Economics, Taipei, Taiwan.

Lee, C. S., P. J. Kim, Y. H. Park, and H. K. Kwak (2000), "Determination of Nitrogen Balance of Agricultural Land among OECD Nutrient Balance Indexes," *Korea Journal of Soil Science and Fertiliser*, 33(5): 347-355.

Lee, Y. (2003), "Nutrient Balance of Agricultural Land in Korea," *Soil and Fertiliser*, 14: 28-39.

MAFRA (2016a), Key Statistics on Agriculture, Food and Rural Affairs, Ministry of Agriculture, Food and Rural Affairs, Sejong-si, Korea.

MAFRA (2016b), Grain Policy Data.

MAFRA (2011), Third Five-Year Plan to Promote Environment-Friendly Agriculture.

Melitz, M. and S. Polanec (2012), "Dynamic Olley-Pakes Productivity Decomposition with Entry and Exit", *NBER Working Papers* 18182, National Bureau of Economic Research, Inc.

Ministry of Economy, Trade and Industry of Japan (2017), *Census of Manufacture*, http://www.meti.go.jp/english/statistics/tyo/kougyo/index.html

MOLIT (2013), Water Vision 2020.

OECD (2017a), *OECD Regional Database*, OECD Publishing, Paris (accessed 30 June 2017).

OECD (2017b), OECD Agri-Environmental Indicator Database, http://stats.oecd.org/.

OECD (2016a), *OECD Economic Surveys: Korea 2016*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eco_surveys-kor-2016-en.

OECD (2016b), OECD.Stat (database), http://stats.oecd.org/.

OECD (2016c), "Producer Incentives in Livestock disease Management: A Synthesis of Conceptual and Empirical Studies", TAD/CA/APM/WP(2016)6/FINAL.

OECD (2016d), OECD System of National Accounts, OECD Annual Labour Force Statistics

OECD (2013), *OECD Compendium of Agri-environmental Indicators,* OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264186217-en.

OECD (2008), *Evaluation of Agricultural Policy Reforms in Korea*, OECD Publishing, Paris, www.oecd.org/tad/agricultural-policies/40383978.pdf.

OECD (2001), *Environmental Indicators for Agriculture: Methods and Results Volume 3*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264188556-en.

Olley, S. and A. Pakes (1996), "The Dynamics of Productivity in the Telecommunications Equipment Industry", *Econometrica* 64: 6, 1263-1297.

Shim, K., S. Min, D. Lee, G. Kim, H. Jeong, S. Lee and K. Kang (2011a), "Simulation of the Effects of the A1B Climate Change Scenario on the Potential Yield of Winter Naked Barley in Korea," *Korean Journal of Agricultural and Forest Meteorology*, 13(4): 192-203.

Shim, K., D. Lee, S. Min, G. Kim, H. Jeong, S. Lee and K. Kang (2011b), "Assessing Impacts of Temperature and Carbon Dioxide Based on A1B Climate Change Scenario on Potential Yield of Winter Covered Barley in Korea," *Climate Change Research*, 2(4): 317-331.

UN Comtrade (2015), United Nations Commodity Trade Statistics (database), http://comtrade.un.org/.

USDA (2015), *Agricultural Productivity Database*, Economic Research Service, United States Department of Agriculture.

Wijnands, J. H., Siemen van Berkum, and David Verhoog (2015). *Measuring Competitiveness of AgroFood Industries: the Swiss case*, OECD, Paris.

Wijnands, J. H., van der Meulen, B. M., Poppe, K. J. (2007).*Competitiveness of the European Food Industry: an economic and legal assessment 2007*. Office for Official Publications of the European Communities.

World Bank (2016), *World Development Indicators* (database), http://data.worldbank.org/indicator.

Chapter 3. Economic and institutional environment in Korea

This chapter gives an overview of the performance of the overall economy, macroeconomic developments and challenges, governance and institutions, and general incentives in Korea for investments by firms, including farms, input suppliers and food companies. It discusses basic conditions for investment established by the overall regulatory environment; trade and investment policy, which influences the flow of goods, capital, technology, knowledge and people needed to innovate; and access to credit needed to innovate. The general fiscal policy and the treatment of agriculture are then discussed. Specific obstacles and incentives for investment in the agricultural sector are dealt with in later chapters of this report.

3.1. Macroeconomic policy environment and governance

At the broadest level, stable and sound macroeconomic policies, leading to high growth and low and stable inflation rates, play an important role in setting a favourable environment for investment in farms or agri-food firms seeking to introduce new products, to adopt new production methods, or to undertake organisational changes that can lead to higher productivity growth and more sustainable use of natural resources. Assessment of the country's overall growth and growth potential in the short- to medium-term has implications for sector-specific prospects as well. In some circumstances, macroeconomic policies and their impacts can contribute to implicit and perhaps unintended biases for or against the food and agriculture system.

Macroeconomic environment

Over the long-term, macroeconomic indicators show that Korea's economy is improving in various aspects. It has had the fastest growing per capita income among other OECD economies over the past 25 years, sustaining double-digit export growth in volume, which helped it become the 6th largest exporter and 11th largest economy in the world by 2015 (OECD, 2016a). The per capita GDP gap narrowed from 65% of the OECD average in 2000 to 93% in 2015. Labour productivity has risen sharply over the last two decades to nearly three times the OECD average. However, the productivity gap between the manufacturing and service sectors is still a concern. Productivity in services, which is around 90% of that in manufacturing in the average OECD economies, was 45% in Korea.

Korea is an export-oriented economy. The trade share in Gross National Income (GNI) increased from 35% in 1970 to 81% in 2016 and peaked at 114% in 2011. The contribution of net exports to economic growth averaged 45%, which is compatible with the contribution made by domestic consumption and investment of 55% (Jung et al., 2013). Major trading partners are the People's Republic of China (hereafter "China"), Japan, the United States, the European Union and ASEAN. Studies find that a rapid expansion of FTA with major economies has led to greater volumes of trade and varieties of products (Bae et al., 2012; Civic Consulting & Ifo Institute, 2017; USITC, 2016). China accounts for a quarter of Korean exports and is a key source of demand, along with other countries in Asia.

According to the United Nations (UN), the inward foreign direct investment stock of Korea expanded nearly ten times to USD 179.5 billion in 2015 from USD 18.2 billion in 1995. However, the outflow expanded more than 20 times over the same period, from USD 13.3 billion to USD 306.1 billion. Despite a recent slowdown in export growth, the current account surplus has risen to nearly 6% of GDP, reflecting weak domestic demand, falling oil prices and transitory demographic trends (Table 3.1). High household debt, which rose to KRW 1 296 trillion (USD 1.1 trillion) as of 2016, has tended to exert a drag on private consumption. Despite the government's efforts to reduce the household debt, its growth rate accelerated to 11% in 2016 compared to 5% before 2010.

Table 3.1. Key indicators of Korea's economic performance, 1990 to 2017

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016e	2017e
Real GDP growth, %	9.8	9.6	8.9	3.9	6.5	3.7	2.3	2.9	3.3	2.6	2.7	2.6
General government financial balance[1]	2.4	3.1	4.4	1.6	1.0	1.0	1.0	1.3	1.3	1.4	1.9	2.5
General government gross debt[2]	13.0	8.9	26.2	35.8	33.5	36.1	38.5	40.5	43.7	44.2	44.2	43.3
Current account balance[1]	-0.9	-1.8	1.9	1.4	2.7	1.6	4.1	6.2	6.0	7.7	7.1	6.4
Exchange rate, (Won per USD)[3]	708	771	1 130	1 024	1 155	1 107	1 125	1 094	1 052	1 130	1 158	0
Inflation, annual %, CPI all items	8.6	4.5	2.3	2.8	2.9	4.0	2.2	1.3	1.3	0.7	0.9	1.5
Unemployment rate, %[4]	2.4	2.1	4.4	3.7	3.7	3.4	3.2	3.1	3.5	3.6	3.8	3.8

Notes: e: OECD Economic Outlook estimate.
1. As a percentage of GDP.
2. As a percentage of GDP at market value.
3. Period average.
4. End year, as a percentage of total labour force.
Source: OECD (2016b), *OECD Economic Outlook*, Vol. 2016/1, OECD Publishing, Paris. Last updated June 2016, http://dx.doi.org/10.1787/eco_outlook-v2016-1-en.

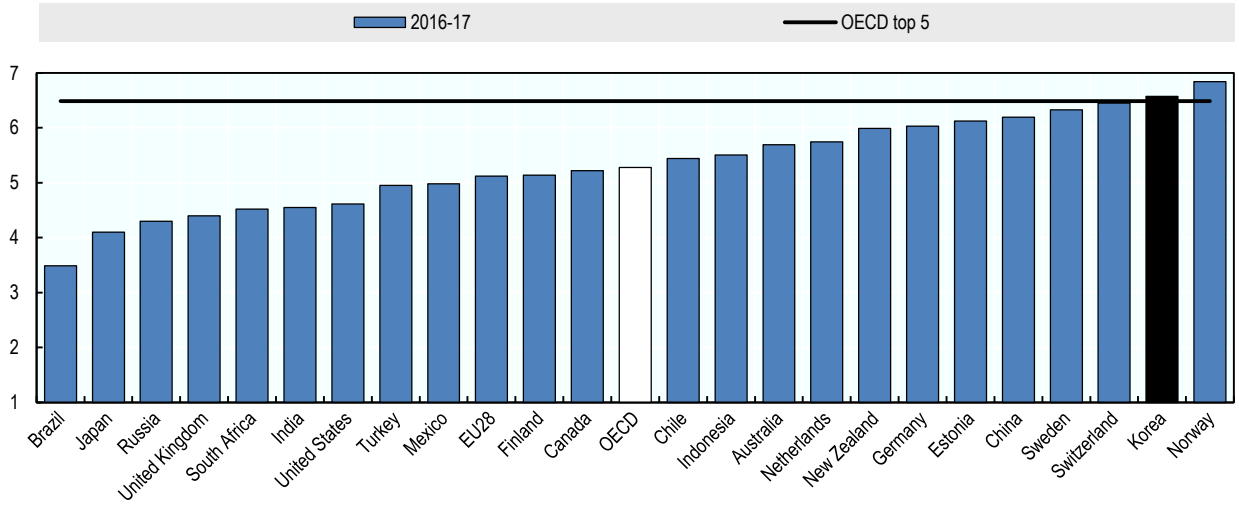
StatLink https://doi.org/10.1787/888933852331

The World Economic Forum (WEF) Global Competitiveness Indicators for 2016-17 rank Korea at 26th place out of 138 (Figure 3.1). This stable overall position conceals some notable improvements in several pillars:

- The **macroeconomic environment** is performing well. Building on a healthy financial situation, Korea moved up two places to rank third in the macroeconomic environment pillar, scoring higher than the average of the top five OECD countries.
- **Institutions** have conspicuously improved. Improved public-sector performance, security and corporate accountability have led to an advance in the institutions pillar to 63rd position.
- The **infrastructure** is considered excellent. Korea has joined the top 10 performers in this pillar for the first time due to the high quality of its transportation, electricity and communication infrastructure.
- The **labour market** is improving, but from a low base (77th position): it notably ranks 113th for the ease of firing and hiring workers, 112th for the average cost of redundancy, and 135th for the quality of social dialogue. Labour market efficiency is one of the areas where Korea has struggled the most.
- **Financial development** (80th position) has improved markedly after several years, although credit access conditions and low confidence in the banking system remain a concern.
- **Innovation** is considered as highly reliable (20th rank).

Figure 3.1. Global Competitiveness Index: Macroeconomic environment, 2016-17

Scale from 1 (worst) to 7 (best)



Note: OECD top 5 refers to the average of the scores for the top 5 performers among OECD countries (Switzerland, Finland, Luxembourg, Netherlands and New Zealand). Indices for EU28 and OECD are the simple average of member-country indices.
Source: World Economic Forum (2016), The Global Competitiveness Report 2016-2017: Full data Edition, Geneva 2016. www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1.

StatLink https://doi.org/10.1787/888933851609

Governance and Institutions

Central government

The country has a unicameral Parliament, the National Assembly, 253 of whose 300 members are elected by a simple majority rule from the same number of local constituencies; the rest are elected from national lists of political parties. In addition to legislative power, the National Assembly has the right to consent to the appointment of Prime Minister by the President, to open a hearing to assess the appropriateness of nominees for an office of a minister in the government, to amend the government's budget proposals and to approve them.

The President of Korea is directly elected by popular vote. The President and the Executive Body have considerable power in both legislative and budgetary processes. Subject to the government's consent, the National Assembly can increase the number of individual items in the government's annual budget proposal.[1] Because it is equipped with relatively richer budget and personnel resources than the Legislature, and with strong discretionary powers in the execution of laws, the Executive has flexibility in policy design and implementation.

Local government

The Constitution stipulates that the local governments are responsible for matters pertaining to the welfare of local residents and management of properties. The Law on Local Autonomy adds the promotion of industry to their responsibilities, which include agriculture, regional development and environmental facilities, promotion of education, sports, culture, and arts, and regional civil defence and firefighting.

Currently there are 17 units of larger local governments (Provinces and Special Cities) and 226 basic local governments (Cities, Counties, and *Gu*). Each local government has a Governor or Mayor, who is elected by a popular vote, and Councils whose members are directly elected from constituencies. The local governments play an important role in the implementation of some agricultural policies such as the processing of applications for direct payment programmes and disbursing those payments.

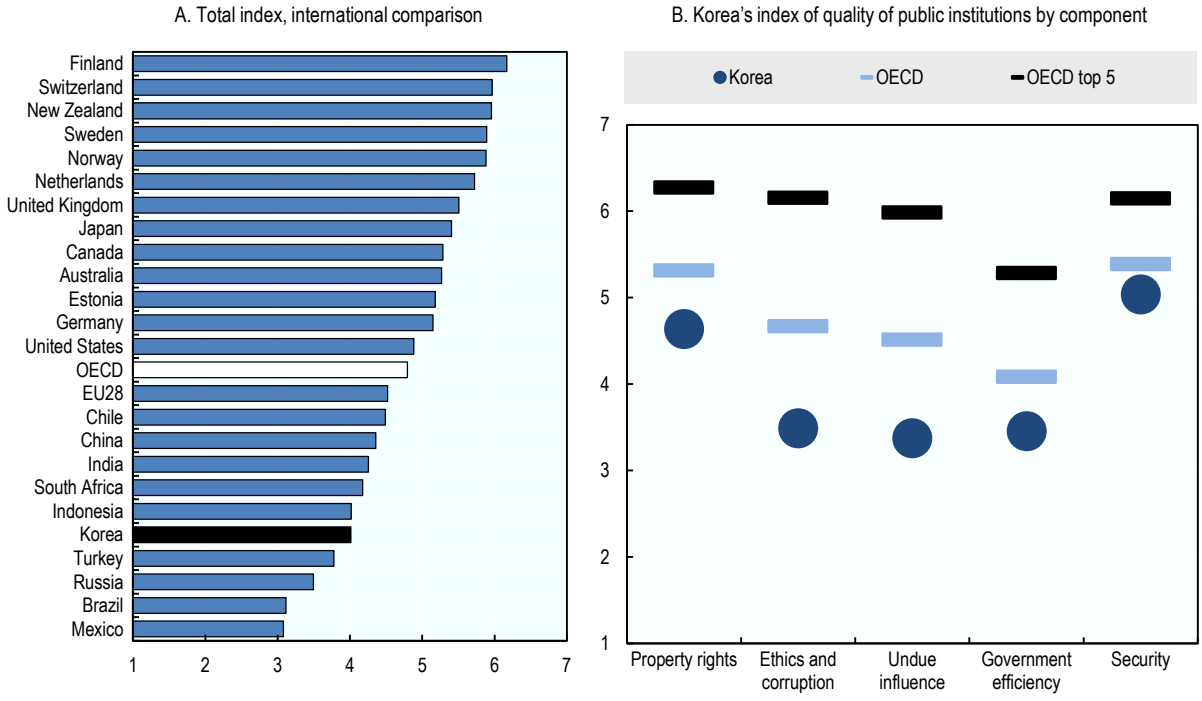
Quality of governance

Korea has developed well-functioning public institutions to secure transparent and inclusive governance. For example, Korea is among the few countries that oblige the inclusion of advisory or expert groups in the policy process, and to have whistle-blower protection legislation for all public sector employees and suppliers (OECD, 2015a). In 2015, Korea scored above the OECD average in stakeholder engagement for developing regulations and regulatory impact assessment in the OECD indicators of regulatory policy and governance. It scored around the average for *ex post* evaluation of regulations (OECD, 2015b).

However, public perceptions of government performance indicate considerable room for improvement. Opinion surveys carried out in the business community database suggest that Korea ranks among the lower group of OECD countries in terms of the overall index of quality of public institutions (Figure 3.2.A). In comparison to other OECD countries, it performs weakly in “ethics and corruption” and “undue influence” (Figure 3.2.B). A closer look at the sub-indices of the quality of public institutions reveals that Korea’s weak point lies especially in public trust in politicians, favouritism in decisions of government officials, the burden of government regulation, and the transparency of government policy making.

Figure 3.2. Global Competitiveness Index: Quality of public institutions, 2016-17

Scale from 1 (worst) 1 to 7 (best)



Notes: Indices for EU28 and OECD are the simple average of member-country indices. OECD top 5 refers to the average of the scores for the top 5 performers among OECD countries (Finland, Switzerland, New Zealand, Sweden and Norway).

Property rights refers to the average of the indices: Property rights and Intellectual property rights. Ethics and corruption refers to the average of the indices: Diversion of public funds, Public trust in politicians and Irregular payments. Undue influence refers to the average of the indices: Judicial independence and Favoritism in decisions of governmental officials. Government efficiency refers to the average of the indices: Wastefulness of government spending, Burden of government regulation, Efficiency of legal framework in settling disputes, Efficiency of legal framework in challenging regulations and Transparency of government policymaking. Security refers to the average of the indices: Business costs of terrorism, Business costs of crime and violence, Organized crime and Reliability of police services.

Source: World Economic Forum (2016), *The Global Competitiveness Report 2016-2017: Full data Edition*, Geneva 2016, www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1.

StatLink https://doi.org/10.1787/888933851628

3.2. Regulatory environment

The overall regulatory environment establishes basic conditions within which all firms, including farms, input suppliers and food companies, operate and make investment decisions. Competitive conditions in domestic markets, including low barriers to entry and exit, can encourage innovation and productivity growth, including through their impact on structural change. Regulations may also enable or impede knowledge and technology transfer directly, contributing to more or to less innovation, including in sustainability-enhancing technologies.

Regulatory environment for entrepreneurship

Korea ranks fifth out of 189 countries in the World Bank's "Ease of doing business" index (World Bank, 2017). Korea led in two categories – Getting Electricity and Enforcing Contracts – and 11th in Starting a Business, but some areas need further improvement, such as Dealing with Construction Permits, Registering Property, and Getting Credit. In 2014, the Government launched the "cost-in, cost-out" approach to avoid introducing unnecessary new regulations. From January 2014 to January 2015, the number of economic regulations was cut by 10% (WTO, 2016).

The Korea Fair Trade Commission (KFTC) is an independent agency that is mandated to prevent anti-competitive market structures through merger enforcement, to remove regulations that hinder competition, to deter cartels and vertical restraints, to improve conglomerate ownership structure and transparency, to promote fairness in transactions with consumers, and to strengthen private enforcement against unfair practices. KFTC also applies laws to protect SMEs and is involved in regulating the *chaebol* conglomerate business groups. While enforcing laws about cartels and mergers and eliminating regulations that constrain market competition are important, the KFTC has placed equal importance on reforming the ownership and investment structures of the *chaebol* (OECD, 2007).[2]

Box 3.1. Agricultural co-operatives in Korea

Korea's primary agricultural co-operatives are comprised of 1 052 regional agricultural co-operatives and 79 commodity specialised agricultural co-operatives. Regional agricultural co-operatives are composed of 936 regional crop farming co-operatives and 116 regional livestock co-operatives. Commodity specialised co-operatives are comprised of 45 crop co-operatives, 23 livestock co-operatives of specific livestock, and 11 ginseng co-operatives. Primary co-operatives have been continuously merged to improve operational efficiency, decreasing their number from 1 277 in 2006 to 1 131 in 2017. The primary co-operatives compose the National Agricultural Co-operative Federation (NACF). In Korea, both NACF and primary co-operatives conduct banking and insurance business, and input supply and marketing business.

The majority of profits of primary agricultural co-operatives are accrued to the banking and insurance business and the primary co-operatives have been relying on profits from financial business to continue their input supply and marketing business. NACF provided financial support to primary co-operatives to support their input supply and marketing business based on its earnings from financial business (KREI, 2015a). In 2012, the financial and other business operation of NACF was separated to two holding companies (NH financial holding company and NH business holding companies). The regional co-operatives also separate the accounting for the financial and other business activities to distinguish profit and loss for each account, but the settlement of assets, debt, capital, costs and revenue are based on a single account.

As of April 2017, the total membership of primary agricultural co-operatives is 2.25 million. Any farmer that satisfies specific conditions is eligible for membership; conditions include cultivating or managing more than 0.1 ha of farmland and working more than 90 days per year in farming. Farms can join their regional agricultural co-operatives while simultaneously being members of product co-operatives. Non-farmers are also allowed to be associated members if they pay a membership fee. However, associate members do not have voting rights in the management of the co-operative.

Because the basic objective of agricultural co-operatives is to provide mutual aid among small-scale farmers, the co-operatives have been exempted from certain provisions of the Monopoly Regulation and Fair Trade Act, conditional on this arrangement not undermining the basic principles of

economic order. Legitimate joint purchase and sale activities of agricultural co-operatives are subject to tax reduction or exemption in: value-added tax applied to agricultural inputs and equipment; sales tax; interest income and dividend income on deposits and contributions of members; and corporate income tax. Moreover, government programmes such as subsidised credit have been channelled through primary agricultural co-operatives.

As of 2016, NH's marketing share of total agricultural products is 49.2%, and average marketing share by major item is as follows: horticultural products 60.2%, grains 50.6% and livestock products 39.2%. NH dominates fertiliser supply in Korea: it supplies nearly 100% of fertilisers for rice farming, 80% of fertilisers for horticulture and 97% of other fertilisers. NH business holding company established a subsidiary company to produce fertilisers (Namhae Chemical), which account for approximately one-third of the fertiliser production in Korea. NH's volume-based share of fertiliser marketing is around 97.2% and its value-based share is about 95.9% as of 2013 (KREI, 2015a). NH supplies its members with farming materials such as pesticides and feeds to increase their income by reducing the cost of farming. The NH's share of the pesticide and feed markets was about 15% and 18% respectively in 2016. As a stable supply of agricultural materials such as fertilisers and pesticides at appropriate prices has been the most important task of agricultural co-operatives since the 1960s, NH has concentrated on the fertiliser industry with the support of the Korean government; the original purpose was to allow farmers to obtain fertilisers at a low cost and increase yields.

Regulations on natural resources

Regulations on natural resources are central to ensuring their long term sustainable use and in large part determine access to and use of land, water and biodiversity resources.[3] They also impose limits on the impact of industrial and agricultural activities on the state of natural resources (e.g. water pollution, soil degradation, greenhouse gas emissions). The design of natural resource and environmental policies is important in terms of the incentives they generate for innovation and sustainable productivity growth.

Framework of environmental regulation

The first national level legal step for environmental and natural resource conservation policies in Korea was the introduction of the Act on the Prevention of Pollution in 1963. The law itself did not contain regulations in detail, and the emission standards were introduced only when the Act on the Prevention of Pollution was amended in 1971. Technology standards for polluting firms were introduced in 1978. The Environmental Office, which has become the Ministry of Environment of Korea (ME), was established in 1980 as an independent government agency (Korea Environment Institute, 2004).

Until the late 1980s, most environmental regulations in Korea were direct controls or command-and-controls. The importance of reforming environmental regulations by introducing incentive systems was much emphasised in the early 1990s. The current environmental regulatory system in Korea comprises direct controls and incentive systems. Direct controls include emission standards, ambient standards, and technology standards. Technology standards are imposed mostly on sources emitting highly intensive pollutants and involve the installation and operation of preventive facilities. ME sets ambient standards of air, water, noise, and soil, and imposes emission limits or standards on emission sources in order to achieve them (Kwon, 2013).

The incentive system in environmental conservation has become an important source of government budgets for environmental policy, providing 14.1% of the ME budget in 2016

(ME, 2016a). Several types of emission fees or charges apply to types of pollutants and amounts of emissions, varying to account for regional differences. A deposit-refund system promotes collection and recycling of waste. Product charges are imposed on products with high environmental burden at the stage of production or consumption. Fees are imposed on specific natural resource developers such as bottled water producers. Water Use Charges are imposed on consumers drinking tap water if its source is one of four major rivers. Economic activities of pollution sources located upstream of rivers are strictly regulated (Kwon, 2013).

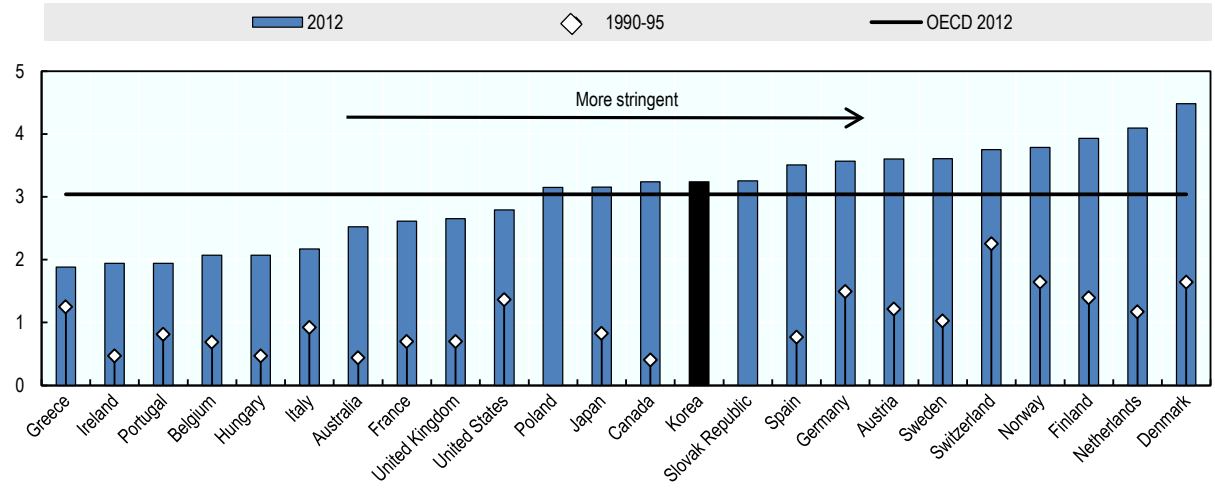
In 2007 the National Strategy for Green Growth and the Five-Year Plan for Green Growth were launched. Both aimed at reducing CO_2 emissions and escaping from the global economic crises by boosting green industries. The three growth strategies of the Plan were: 1) adapting to climate change and improving energy self-sufficiency; 2) creating a new growth momentum; and 3) improving the quality of life and enhancing national status. The national target level of CO_2 emissions was unveiled for the first time as a policy goal, and a nationwide CO_2 emission trading scheme was introduced in 2015 as a result. The policies were followed through by the establishment of the Presidential Committee on Green Growth.

For the agricultural sector, the National Strategy for Green Growth emphasised the following: 1) reducing emission of nitrous oxide and methane from agricultural production; 2) building a carbon circular society by reducing food waste, planting woody crops on idle lands, introducing minimum tillage and crop residue management, and constructing bio-gas production systems; 3) adapting to climate change by R&D investment in breeding, integrated management of soil and nutrition, and improved pest and disease control; 4) developing new growth areas such as biological pesticides and organic fertilisers, high valued-added seed industries, and new material and new crops based on biotechnology and nanotechnology; and 5) developing food industries by developing food technology, globalising Korean traditional foods, and constructing a national food industry cluster (Kim, 2009).

According to the OECD indicator, environmental policy in Korea is slightly more stringent than the OECD average in 2012 (Figure 3.3). Measures are focused on energy sector regulations but complemented by information on other types of environmental policies.

Most of the regulations introduced and controlled by ME are applied to non-agricultural sectors. However, there are specific environmental regulations affecting agricultural activities as well, such as regulations on livestock manure management, pesticide containers, soil quality management, land conversion, forest management, and groundwater and watershed management. MAFRA is in charge of some of those regulations. Some of the regulations affecting agricultural activities take the form of subsidies. For instance, the Water Use Charges (or River Basin Fund) paid by downstream urban residents are used to assist the upstream rural residents whose economic activities are regulated for river water quality preservation.

Figure 3.3. Stringency of environmental policy in selected OECD countries, 1990-95 and 2012



Note: For Korea, Poland and the Slovak Republic, 1990-95 average is not available.
Source: Botta, E. and T. Koźluk (2014), "Measuring Environmental Policy Stringency in OECD Countries: A Composite Index Approach", *OECD Economics Department Working Papers*, No. 1177, http://dx.doi.org/10.1787/5jxrjnc45gvg-en.

StatLink https://doi.org/10.1787/888933851647

Regulation on soil preservation

Uncontaminated land, water, and air are the three fundamental environmental resources required for agricultural production. The Soil Environment Conservation Law introduced in 1995 pursues both the prevention of human and ecosystem damage caused by soil contamination and the purification of contaminated soils. The law regulates 21 polluting substances and imposes two contamination standards: the worrisome level and the countermeasure standards. The worrisome level is the level of contamination that merits concern about damage to humans and the ecosystem. The countermeasure standards set out levels of contamination requiring countermeasures (ME, 2016a).

The Soil Environment Conservation Law is strictly based on the "polluter pays" principle (PPP). Not only are the owners and operators of polluting facilities legally responsible for contamination, but so too are future owners of the facilities. The liability of polluters includes soil purification as well as compensation for the damage incurred (Choi, 2007). Because the owners of the facilities are responsible for the damage, the Law creates an incentive for a voluntary soil environment assessment when a site which may be contaminated is traded. Currently there are 2 000 soil environment monitoring sites. For the agricultural sites, the soil monitoring system monitors 188 sites of forestry areas, 247 sites of paddy fields, 20 sites of pastures, 146 sites of non-paddy fields, and 24 sites of orchards. In 2011, the contamination levels of even the most seriously contaminated agricultural sites did not reach the worrisome levels (Kwon et al., 2013).

Korea also has a system of designating and preserving Natural Environment Protection Areas. The main purpose is to conserve and manage ecosystems and biodiversity in the designated areas. Periodic surveys on the natural environment are conducted, and an information network on the resources is constructed. There are long-run projects of building and managing databases of the natural environment, drawing up ecosystem and nature maps, and conducting researches for biological diversity protection (ME, 2016a).

Regulation on fertiliser and pesticides

Because of their potential to contaminate soil, chemical fertilisers and pesticides can be registered, sold and used only if they satisfy ingredient standards and pass safety tests. Additionally, safety and pesticide residue regulations on crops induce producers to use an appropriate level of chemicals voluntarily. However, the uses of chemical fertilisers and pesticides are declining mostly due to the decline in cropping land area and elimination of subsidies.

The Fertiliser Control Act manages the quality and safety of fertiliser via the "legal standards" of the Rural Development Administration (RDA). These standards indicate the minimum quantity of main ingredients, the maximum allowable content of harmful ingredients, and the content of additional ingredients. The regulation on pesticide has been converted from a negative list system to a positive one. The purpose of managing the list of permissible pesticides is to prevent their overuse or misuse and to control unregistered pesticides used on imported agricultural products. Pesticides being used domestically or on imported products are required to be registered. Maximum residue limits are applied to registered pesticides, while a residue limit of 0.01 mg/kg is applied to every non-registered pesticide. The RDA manages the registration system.

The Ministry of Environment is considering introducing a Total Maximum Nutrient Loading System to control overuse of inorganic fertilisers, as is already being implemented in the United States and the European Union. Under this system, nutrient inputs and outputs of each region will be investigated and use of nutrient inputs will be controlled at the level that the absorptive capacity of soils can accommodate. Moreover, the government supports developing nutrient-reducing practices such as improved fertilisation and the rotation system, and inducing producers' adoption of new practices in pilot study areas. A bottleneck for introducing the Total Maximum Nutrient Loading System is the large amount of livestock manure. Although not chemical, manure compost contains large nitrogen compounds; imposing the System standards on manure compost may limit the size of breeding herds, and possibly damage livestock farms (KREI, 2015b).

Regulation on livestock manure

Livestock manure has become the main agricultural source of water and soil pollution in Korea. Regulations on livestock manure are stipulated under the Act on the Management and Use of Livestock Excreta. The Act was amended in 2006 to emphasise converting manure into resources by composting and liquid fertilisation. The central government financially and technically supports R&D in manure treatment technology. Each province has to establish a 10-year plan of livestock manure management and report it to the Minister of Environment (ME, 2011).

Depending on the size of breeding herds or barns (breeding facilities), animal farms are classified as Facilities subject to Permission, Facilities subject to Reporting, and Facilities without Reporting. Farms with hog barns larger than 1 000 m^2 or cattle barns larger than 900 m^2 are subject to permission. Facilities subject to permission and reporting must install and operate livestock manure treatment facilities which recycle manure by composting or liquid fertilisation; otherwise, manure has to be purified before being discharged. For regions where special steps are required for water pollution prevention, additional regulations are imposed: the barn size criteria requiring permission are reduced to 500m^2 for hogs and 450m^2 for cattle, and treating manure inside the barns as much as possible is required.

A multi-dimensional approach is important to tackle the growing livestock manure management problem (Box 3.2). In Korea, the government has been subsidizing, installing, and operating public manure treatment facilities to reduce the burden of manure treatment on small-scale farms' since 1991. MAFRA and local government provide subsidies and loans to develop composting, liquid fertilising, and energy production by farm households, farmer's organisation, or agricultural companies. Furthermore, the government is investing in constructing large-scale public facilities for converting manure into agricultural resources. Because the size of the livestock industry keeps growing while the total area of crop land is declining, there will be an excess supply of manure composts or liquid fertilisers. The government is running an inspection system of manure treatment and is considering introducing a manure traceability system.

Box 3.2. Comprehensive policy framework for livestock manure management in the Netherlands

The livestock sector in the Netherlands is important to the nation's economy, competitive in international markets and very intensive. The sector produces three to four times more manure than is needed for fertiliser use in the country. A single 500-sow farm producing 20 piglets per sow each year produces the same effluent as a town of 25 000 people, but on a much smaller land area. 80% of manure production (around 70 million tonnes per year) is from cattle, 18% from pigs and 2% from poultry.

The manure management approach adopted in the Netherlands is based on the premise that manure is a valuable product rather than waste and its valorisation can be a key driver of the circular economy. The Dutch manure policy focuses on both the production and the application of manure with the objective of optimising the use of manure through balanced fertilisation and suitable application techniques. The government supports this process through penalising polluters and rewarding innovators and farmers who find ways to export manure. Their multi-dimensional approach entails: i) regulating the use of manure; ii) market-based instruments to facilitate innovation and investment in new techniques, including financing R&D for innovative processing and manure management, and subsidies and tax reductions; iii) capacity building for farmers through farmer networks; iv) partnerships between government, industry, NGOs and R&D institutions; v) international co-operation through multi-stakeholder platforms such as the "Global Agenda for Sustainable Livestock", the "Global Research Alliance on Agricultural Greenhouse Gases" and the "Global Partnership on Nutrient management".

The cornerstone of the Dutch manure policy is a system of application standards for both nitrogen and phosphate on agricultural land. The legislation for using manure on land imposes: i) Application rates: low maximum use of manure per ha land based on phosphate and nitrogen; application in growing season; low emission application techniques, such as obligatory injection of liquid manure; ii) Enforcement: registration of production (livestock, crop and manure); compulsory processing of excess manure into products with high nutrient levels and a low moisture; iii) Obligation to reduce nutrient losses: build low-emission housing and provide emission-free storage. Failure to comply results in an economic offence, which can be investigated and prosecuted under criminal law. All farmers with a manure surplus must develop a disposal plan. Farmers who exceed permitted production levels face fines, and there is an escalating level of tax on commercial feed. A "Manure Board" regulates manure flows, provides manure for use in arable areas, and helps find new manure users. It also conducts research, assists in the processing of manure and establishes treatment plants.

Another essential element of the Dutch manure management system is manure distribution from livestock farms with a nutrient surplus to arable farms that can use the nutrients in crop production. The most common use of animal manure is its application as fertiliser on agricultural land (90% of

all manure). Manure application is only allowed when using low-emission technology like manure injection on grassland and immediate covering with soil on arable land. The manure application period is limited to the early growing season of crops. By using animal manure as a nutrient source for crops, more than 90% of synthetic phosphate fertilisers and more than 60% of synthetic nitrogen fertilisers have been replaced by phosphate and nitrogen from animal manure.

As of 2014, farmers with a phosphate surplus are obliged to process and export a percentage of it. These percentages increase annually until the desired balance between manure phosphate production and available agricultural land or crop uptake in the Netherlands is reached. The percentages are higher for farms in the livestock concentration areas (south and east) than for farms elsewhere in the Netherlands. Large manure surpluses are produced mainly from pig and poultry farms, as they cover little land, while most dairy farms have more land (50 ha per farm on average) and can apply part of the manure to it. Transport is expensive because manure consists largely of water: livestock farmers have to pay the transport companies approximately EUR 10 to EUR 23 per tonne. Transport companies will pay approximately EUR 3 to EUR 10 per tonne to manure-receiving arable farmers; the difference must cover the costs of transportation. Reducing the water content and processing manure to increase organic matter and nutrient content makes distribution more efficient.

The evaluation of the Manure and Fertiliser Act 2016 concludes that the current manure and fertiliser policy reduces environmental problems. Agricultural production is economically and ecologically very efficient per unit of product, but because of its volume, environmental pressure remains high: although balanced fertilisation for phosphate was reached in 2014 and nitrate surpluses have decreased, in southern sandy regions, nitrate concentration exceeds the target, partly due to manure separation and manure fraud.

Over the coming years the focus of manure management policy in the Netherlands will be on three areas:

- Manure processing to increase the export potential of animal manure. In addition, to reduce veterinary health risks, the exported manure must comply with the requirements for animal by-products. Processing methods to improve export opportunities comprise mechanical separation (the initial stage of the processing of liquid manure), manure processing and anaerobic digestion.
- Animal feed agreements with farmers and feed industry: i) to decrease the concentration of phosphate in the feed; and ii) to develop innovations to create more cost-effective feed.
- Fertiliser replacement: upgrading animal manure to products with properties comparable to synthetic fertiliser; increased use of renewable resources; improving the efficiency of fertilisers.

A key lesson from the Dutch approach to manure management is the importance of a coherent system of clear and realistic regulatory standards (e.g. nutrient application standards for agricultural land) which can be adapted as required by local circumstances. An efficient logistics system for manure storage and distribution is also indispensable, as well as accurate records, monitoring, administration and enforcement.

Regulation on air

Korea introduced air quality standards on sulphur dioxide gas for the first time in 1978, since which time the standards have been extended to cover more substances. Air quality standards are reported to be satisfactory for most substances in most regions, but there is a growing concern on fine particulate matters PM10 and PM2.5, whose standards are often not satisfied. Unlike other domestic source substances, emission of VOC (volatile organic

compounds) from automobiles keeps increasing and makes it difficult to control ozone content (ME, 2016c).

All facilities emitting air pollutants are subject to permission or reporting. Facilities are subject to permission if the proportion of a specific air pollutant in emission exceeds a certain level or the facilities are located in a special countermeasure area (the industrial complexes in Ulsan and Yeosu). Facilities are classified into five groups depending on operation scale. Using coal and other types of solid fuels is prohibited in densely populated regions. Restrictions apply to locating facilities in areas with more than 20 000 residents within a 1 km radius, with a high level of specific air pollutant emission, or with a large scale of emission located in a special countermeasure area (ME, 2016c).

Regulation on waste

Waste affects the qualities of soils, water, and air when it is landfilled or incinerated and is classified into municipal waste and industrial waste. Municipal waste is mostly controlled by the pay-as-you-go garbage collection system, while industrial waste is mostly controlled by the deposit-refund system. Food waste is controlled more strictly than other municipal wastes.

Agricultural waste is classified as municipal waste subject to the pay-as-you-go system. The cost of discharge for farm households can be substantial as they have to buy authorised garbage bags to dispose of their waste. Used agricultural plastics and pesticide bottles are collected by designated collectors. Because the number of collectors is limited in remote rural areas, those two forms of waste are not controlled very well in those areas. Incineration or landfill of the waste generates soil and air pollution in rural areas (MAFRA, 2014a). While used agricultural plastics and recyclable bottles are compensated when they are appropriately collected, the per-unit payment is not large enough to induce voluntary collections (MAFRA, 2014a).

Regulation on greenhouse gas

Korea aims to reduce GHG emissions by 37% by 2030 relative to a "business-as-usual" (BAU) baseline. To this end, a GHG emission trading scheme (ETS) was launched in 2015 as the main policy instrument. The ETS covers approximately 525 of the country's largest emitters, which account for around 68% of national GHG emissions (International Carbon Action Partnership, 2017). The ETS allowances are currently allocated for free, thus the government does not collect any revenue from selling them, but they are scheduled to be auctioned in the future. The ETS does not affect agricultural production directly: only a few large agricultural marketing firms participate in the system. However, the system may have indirect effects on agricultural production, particularly if it results in a change in energy prices.

The main strategies of mitigation of GHG emissions from the agricultural sector are: 1) adopting mitigation practices such as altering paddy management practices and improving feed qualities; 2) increasing livestock manure treatment facilities; 3) increasing the share of renewable energies and extending energy saving facilities; 4) undertaking R&D for low carbon agriculture; 5) establishing institutional arrangements that encourage producers' participation in mitigation activities; 6) promoting consumption of low carbon agricultural products; and 7) constructing reliable databases (MAFRA, 2014b).[4]

To encourage producers' participation in GHG reduction, the government monitors and measures farm households' voluntary GHG reduction and buys their certificates. In 2014, 179 farm households participated in the programme (MAFRA, 2014b). The number of public facilities producing composts, liquid fertilisers, and energy with livestock manure is expected to increase up to 150 by 2017, with the central and local governments covering 70% of their total cost (MAFRA, 2016a). The government assists farm households when they install renewable energy or energy-saving facilities (ME, 2016b). It has supported the installation of geothermal pumps, solar power, and wood pallet heaters for greenhouses, barns, and nurseries. A project also exists for the construction of small hydropower generators in agricultural reservoirs (MAFRA, 2012).

Regulations on products and processes

Regulations on products and processes aim to protect human, animal and plant health and can also impact natural resource use. Environmental and health-related regulations can boost innovation by building consumer and societal trust in the safety and sustainability of new products of processes, but unnecessary or disproportionate regulations can stifle innovation and technological development. Food safety and quality standards are also important in developing the food value chain: standardisation of the quality and safety of products reduces the transaction costs of organising vertical co-ordination along the value chain to meet consumers' demand.

Food safety management

Food safety is managed during the process of agricultural production and the process of marketing, processing, and sales. In the process of production, the National Agricultural Products Quality Management Service (NAQS) and the Rural Development Administration (RDA) control the safety of agricultural products based on the Agricultural Products Quality Control Act and the Pesticide Control Act. In the stages of marketing, processing, and sales, the Ministry of Food and Drug Safety (MFDS) manages food safety based on the Food Sanitation Act, although NAQS is also involved in safety control at these stages.

The three main programmes of NAQS are food safety inspection and regulation, country of origin labelling management, and certification of environment-friendly products and good agricultural practices (GAP). The food safety inspection and regulation programme of NAQS investigate residues of pesticides and other noxious substances at the stages of production and marketing as well as agricultural soils, water, and other inputs used for agricultural production. The purpose of the origin of labelling management is to prevent illegal sales of imported products with domestic product labelling, and to provide exact information on the origin to consumers. The system is applied to 220 agricultural products, 257 domestically processed products, 161 foreign processed products, and 20 products used by restaurants.

Regulations on animal and plant quarantine and inspection

Korea's Animal and Plant Quarantine Agency deals with both quarantine and inspection. It runs a situation room for animal disease control and takes preventive measures against food-and-mouth disease (FMD) and avian influenza. The agency quarantines imported animals and plants, monitors imports of living modified organisms (LMOs) and inspects medicine for animals. Since the outbreak of FMD in 2010-11, a livestock farming permission system has been introduced (Box 3.3) for all animal farms with a breeding

facility larger than 50m^2. The permitted farms have to be equipped with certain levels of breeding facilities, ventilation, and a disinfection facility for humans and cars. A limit on the number of breeding herds per square meter is also applied (Ji et al., 2016).

Animal product traceability is applied to swine and cattle. Information from the birth of an animal to the slaughter and sale of meat is collected and provided to consumers. Consumers can trace the information using smart phone applications or the internet. This system contributes to enhancing the reliability of meat products.

Box 3.3. Livestock disease management in Korea

The rapid intensification of livestock production in Korea over the past two decades has substantially increased the risks of occurrence and spread of disease. Since the mid-2000s, the country has experienced serious reoccurrences of highly infectious diseases, such as avian influenza, FMD, brucellosis, bovine tuberculosis and classical swine fever. The highly pathogenic avian influenza (HPAI) was notified to the OIE (World Organisation for Animal Health) in 2003, 2006, 2008, 2010, 2014 and 2015. Occurrences of FMD have caused considerable financial damage: in 2010-11, 153 outbreaks over 145 days prompted the destruction of 3.3 million pigs and 150 000 cattle. The estimated impact on the national budget was KRW 2.7 trillion (USD 2.5 billion), which included the cost of compensation for destroyed animals, the cost of vaccination and of disease control measures. Although the government adopted a policy of nationwide vaccination for all cloven-hoofed animals in 2011, FMD has reoccurred every year since 2014.

Regulation for livestock operations has been significantly tightened, with stringent criteria introduced for production facilities, their location and livestock densities. The legal responsibility of farmers to report disease was increased, with non-compliance leading to large financial penalties and criminal responsibility. Mandatory training for persons involved in breeding and handling livestock was introduced, majority-funded by the state.

Compensation under the disease control and prevention programmes, applied to nationally notifiable diseases, includes: (i) indemnity for direct disease losses, such as dead or destroyed animals; (ii) compensation for consequential losses, such as those from business interruption; and (iii) payments for farmer's ex ante actions, such as subsidising biosecurity investments and operations. The indemnity for direct disease loss is discounted to discourage producer misbehaviour. For example, for those tested positively for FMD, HPAI, classical swine fever or brucellosis, the indemnity is discounted by 20% of the market price. A reduction in indemnity rates is also foreseen in the event of violation of rules for preventive vaccination or failure to comply with disease outbreak control orders as well as delays in reporting. Consequential loss assistance has so far been provided discretionally and only in the cases of large epidemics of FMD and HPAI. Currently, subsidised livestock insurance covers nearly all insurable livestock, but it does not cover the risk related to nationally notifiable diseases (further description of the programme in Section 5.2).

Despite a structural adjustment in livestock sector leading to a concentration of production in larger units, the sector continues to be dominated by small-scale and often non-professional farmers. Substantial farming segments may be facing constraints to undertake adequate investments in biosecurity and in better production technologies to reduce disease risks. The current livestock disease policy seems to be driven mainly by a veterinary and sanitary rationale. However, the improvement of the livestock disease situation in Korea is also a matter of structural policy insofar as it facilitates the establishment of enterprises with adequate investment-generating capacity and higher human capital.

Source: OECD (2017c).

Regulations on GMO

Korea has enacted a law to implement the Cartagena Protocol on Biosafety. The law requires Living Modified Organisms (LMOs) to pass human safety testing and environmental risk assessment. For example, importers of LMOs have to pass the relevant administrative agency's human and environmental risk review. The human safety testing is conducted by the Ministry of Food and Drug Safety (MFDS) and the Korea Centres for Disease Control & Prevention (KCDC). The environmental risk assessment is conducted by the RDA for the crop cultivation environment test, by the National Institute of Environmental Research for the natural ecosystem test, and the National Fisheries Research and Development Institute for the fisheries environmental and marine ecosystem test (Consumer Safety Centre, 2014).

The labelling of GM agricultural products is regulated by the Agricultural Products Quality Control Act, while that of GM food and food additives is regulated by the Food Sanitation Act. Seven agricultural products must indicate LMO content: soybeans, corn, cotton, canola, beet, and alfalfa. The threshold level for labelling of GM ingredients is 3%. Depending on the share of LMOs in the products, the labels have to be written as 'genetically modified [ingredient name]' 'genetically modified [ingredient name] is included,' or 'possibility of including genetically modified [ingredient name]'. For food and food additives, it must be indicated whether GM agricultural products are used as raw materials. The labelling requirement does not apply if genetically modified DNA or exogenous protein has disappeared in the process of manufacturing and processing.

3.3. Trade and investment policy

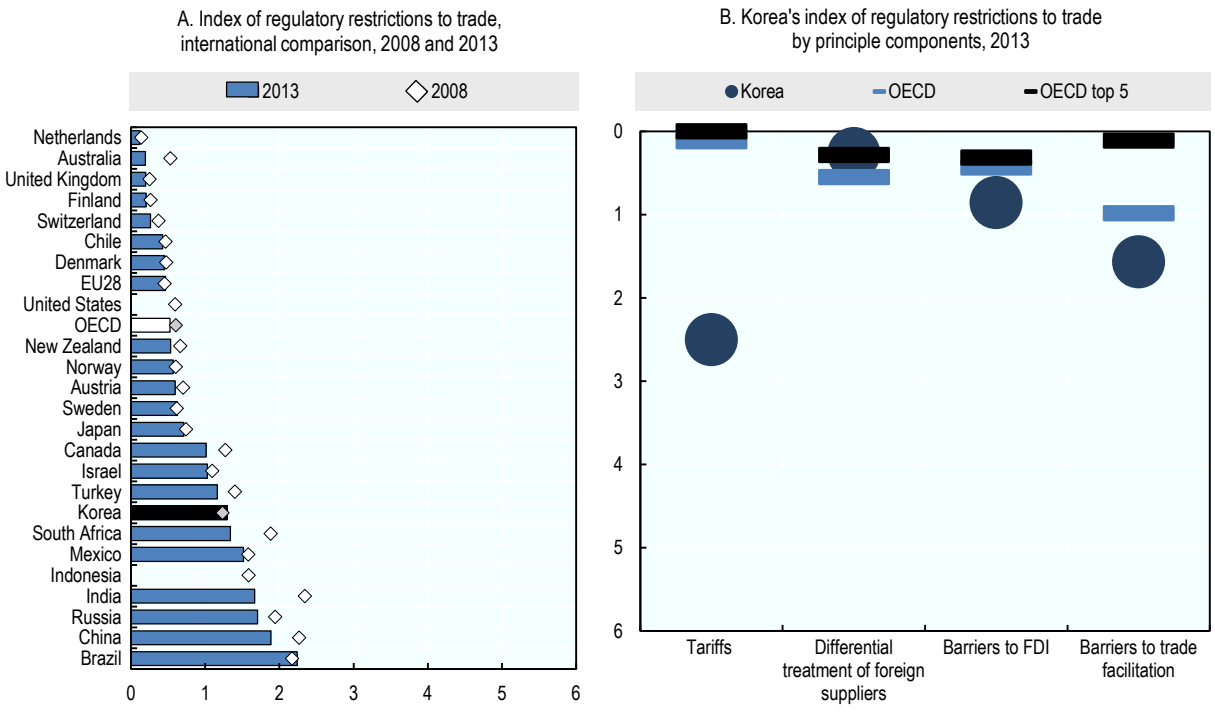
Trade policy

Trade can facilitate the flow of goods, capital, technology, knowledge and people needed to innovate. Openness to trade and capital flows is conducive to innovation as it provides a larger market for innovators, reinforces competition, increases access to new technologies, ideas and processes, including from foreign direct investment (FDI) and related technological spill-overs, and facilitates cross-country collaboration. Trade and investment openness can influence innovation throughout the food supply chain, from input suppliers to food service and retail firms. Input and output markets that operate effectively can foster productivity growth. Trade and investment openness can also facilitate the development of market mechanisms to foster more environmentally sustainable production.

Tariffs remain one of Korea's main trade policy instruments. The average applied Most Favored Nation (MFN) tariff rate was 14.1% in 2016, which is high by OECD country standards. Tariff concessions or drawbacks to ensure that tariffs on intermediate inputs do not become taxes on exports are adding to the complexity of border taxation (WTO, 2016). The OECD Product Market Regulation Database shows that Korea is more restrictive than most OECD countries, in particular in tariff protection (Figure 3.4). This is largely due to relatively high tariffs on agricultural goods. The simple average MFN applied tariff on agricultural goods is 53%, which is the highest among the OECD and large emerging countries.

Figure 3.4. Index of regulatory restrictions to trade

Scale from 0 (least) to 6 (most) restrictive



Notes: Indices for EU28 and OECD are the simple average of member-country indices. OECD top 5 refers to the average of the scores for the top five performers among OECD countries (Netherlands, Belgium, Australia, United Kingdom and Finland). For Indonesia and the United States, 2013 data are not available. For Indonesia and the United States, 2013 data are not available.

The tariff index is based on an average of effectively applied tariffs, scaled within a range between 0 and 6 points, whereby a tariff below 3% is attributed zero points and a tariff above 19.6% is attributed 6 points. Barriers to trade facilitation refer to the extent to which the country uses internationally harmonised standards and certification procedures, and Mutual Recognition Agreements (MRAs) with at least one other country.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Source: OECD (2014), OECD Product Market Regulation Database, http://www.oecd.org/eco/reform/indicatorsofproductmarketregulationhomepage.htm.

StatLink https://doi.org/10.1787/888933851666

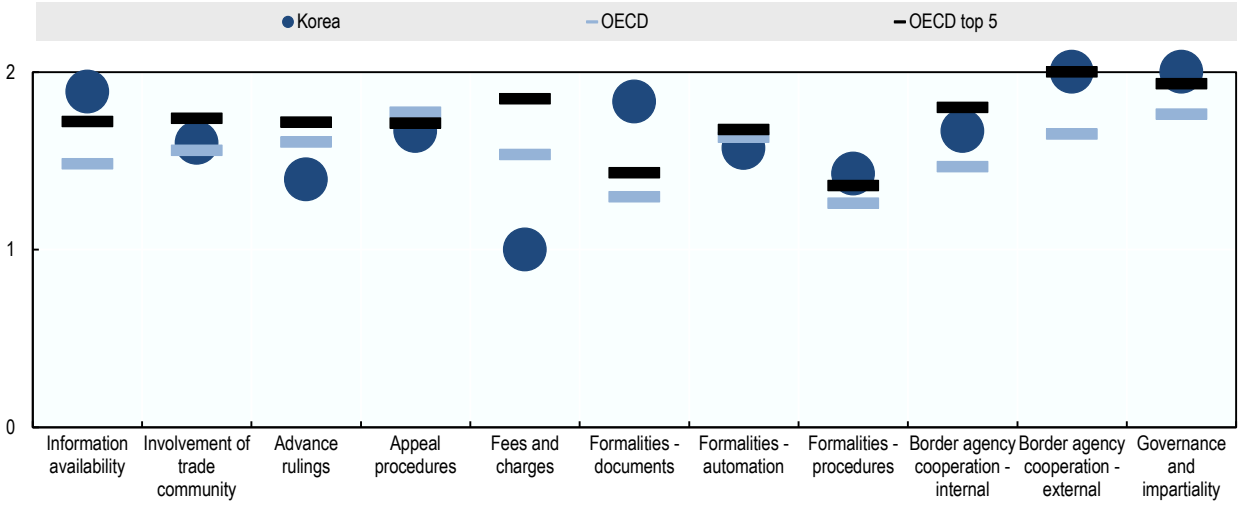
The barriers to trade facilitation index shows Korea is below the OECD average in the areas of internationally harmonised standards, certification procedures and mutual recognition agreements, but its overall trade facilitation performance is comparable with other OECD countries (Figure 3.5). Existing measures on advance rulings can be improved by extending accredited dates of rulings, shortening the ruling periods, and increasing the application rate through active publicity activities.

Growing volumes of trade and increasing number of trading partners oblige Korea to develop a more IT-based, integrated, and automated customs administration. For instance, the Korea Customs e-Clearing System (UNI-PASS) – part of the Korea Customs Service – is the culmination of the past 20 years of experience and know-how in customs administration. The system allows one-stop paperless service operation through an integrated portal; single-window, real-time cargo tracking; and control and facilitation of

passenger clearance. The UNI-PASS system is also connected to a server of the Animal and Plant Quarantine Agency, through which applications for quarantine can be made.

Figure 3.5. Trade Facilitation Indicators: Korean's performance, 2015

Scale from 0 (worst) to 2 (best) performance



Note: Indices for OECD and OECD top 5 are the simple average of country indices. OECD top 5 refers to the average of the scores for the top five performers among OECD countries (Australia, the Netherlands, Ireland, Austria and Canada).
Source: OECD (2015c), Trade Facilitation Indicators, http://www.oecd.org/trade/facilitation/indicators.htm.

StatLink https://doi.org/10.1787/888933851685

Restrictiveness of FDI

The Korean government enacted the Foreign Investment Promotion Act (FIPA) in 1998 to attract FDI in the aftermath of the Asian financial crisis. A series of the amendments of FIPA improved the FDI environment by liberalizing additional sectors, rationalizing the control and management service, removing restrictive measures, strengthening investment incentives, and streamlining the application and report procedures. The government provides a range of incentives for foreign investors comprising tax abatement and exemption for corporate tax, income tax, acquisition tax, registration tax and aggregate land tax. Cash grants are also available from the central and local governments in the event that foreigners purchase land or lease factory facilities and manage employment, education or training of workers. Industrial site support comprises leasing land to foreign firms at a lower rate or for free. However, the cost effectiveness of these incentives remains questionable (WTO, 2016).

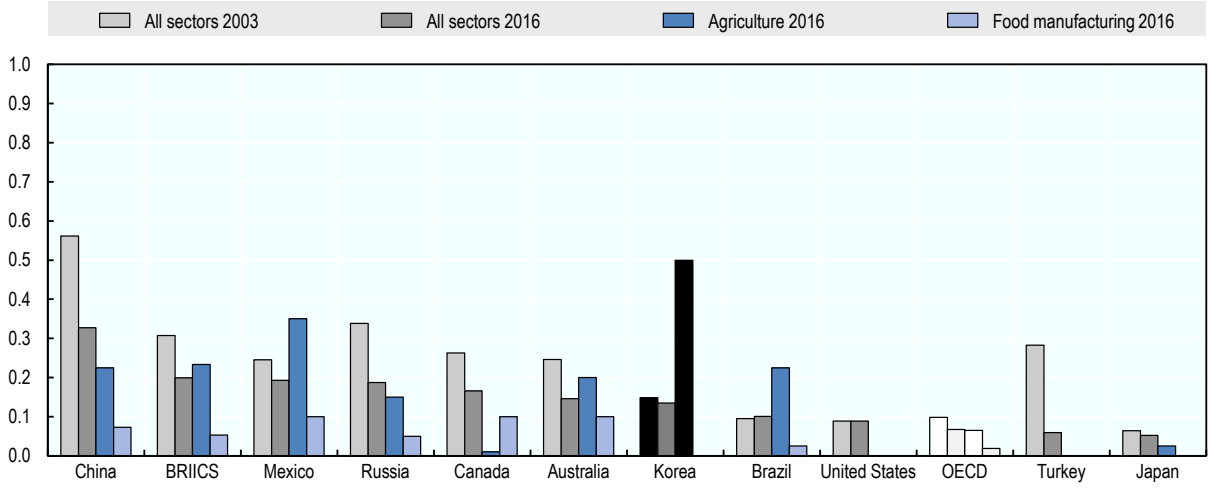
FDI caps are in place in several sub-sectors. For example, foreign investors are not allowed in the cultivation of grains and other food crops. Foreign ownership cannot exceed 50% of beef cattle breeding and the wholesale meat businesses. Foreign investors cannot own financial services provided by agricultural co-operatives. Official approval is required for foreign investment in financial services, while prior notification by foreigners is needed in various other subsectors (WTO, 2016).

According to the OECD FDI regulatory restrictiveness index, Korea has more restrictive regulation than the OECD average, with agriculture one of the most restrictive sectors

(Figure 3.6). Although Korea achieved the largest improvement in the FDI index between 1997 and 2010 among 40 OECD and emerging economies, the improvement has slowed down in more recent periods. Similarly, the agricultural FDI index was halved from 1.0 in 1997 to 0.5 in 2003 but remained at the same level until 2016.

Figure 3.6. Foreign Direct Investment (FDI) Regulatory Restrictiveness Index by sector, 2003 and 2016

Scale from 0 (least) to 1 (most) restrictive



Notes: Countries are ranked according to "All sectors" 2016 levels.
Indices for OECD are the simple average of member-country indices. Four types of measures are covered by the FDI Restrictiveness Index: 1) foreign equity restrictions, 2) screening and prior approval requirements, 3) rules for key personnel, and 4) other restrictions on the operation of foreign enterprises.
Source: OECD (2017a), "OECD FDI Regulatory Restrictiveness Index", *OECD FDI Statistics* (database), http://www.oecd.org/investment/fdiindex.htm.

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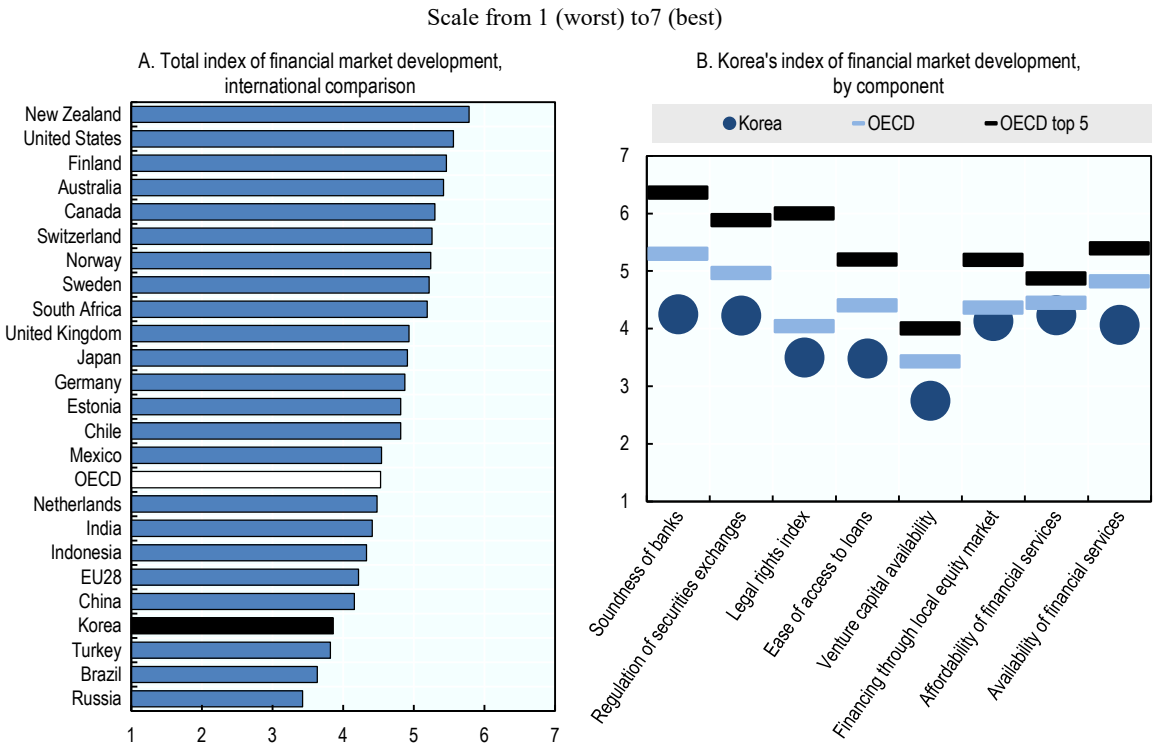
3.4. Financial market policy

Access to financial services can be limited or unequal across regions and firms when financial markets fail or when risks are too high. Policies that improve the functioning of financial markets can facilitate productivity enhancing investments in agriculture and farm size growth. Policies may also facilitate access to funding for sustainability-enhancing investments. Low cost loans and venture capital can also be an important source of funding for innovative firms with high growth potential.

Korea ranks lower for financial market development than most OECD member countries on the Global Competitiveness Index and below the OECD averages for all financial market development components (Figure 3.7). While rising household debt and large corporate loans to weak sectors, such as shipbuilding, boosted the banking sector's risk-weighted assets, the ratio of regulatory tier 1 capital to risk-weighted assets was the lowest in the OECD, at 11.7% in 2015 (OECD, 2016a).

Figure 3.7. Global Competitiveness Index: Index of financial market development, 2015-16



Notes: Indices for EU28 and OECD are the simple average of indices. OECD top 5 refers to the average of the scores for the top five performers among OECD countries (New Zealand, United States, Finland, Australia and Canada).
The Legal rights index is scored on a scale from 1 to 10 based on calculations by the WEF from the World Bank–International Finance Corporation's Doing Business 2013 and then rescaled to 1 to 7 scale by the OECD.
Source: World Economic Forum (2016), *The Global Competitiveness Report 2016-2017: Full data Edition*, Geneva 2016, www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1.

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Korea's household debt was 163% of household disposable income in 2014, well above the OECD average of 137% (OECD, 2016a). Older persons, the self-employed and low-income workers in particular face high debt burdens, raising social cohesion concerns, as financial institutions have become increasingly reluctant to lend to such persons (Jones and Kim, 2014). The high level of household debt has also been a policy issue in agriculture, particularly in capital-intensive sectors (Box 3.4).

Mutual finance institutions are the main player in rural finance. They include NH, regional credit unions (CU), community credit co-operatives and regional fisheries co-operatives. Among the four institutions, the market share of NH was 58.1% in deposits and 57.6% in loans in 2015, according to the National Credit Union Federation. However, the majority of NH loans are provided to the non-farm sector. Total liabilities of farm households and agricultural corporations accounted for 31% of total loans in 2015.

The Korean government plays a dominant role in assisting farmers to finance their investment though grants, subsidised loans and credit guarantees. NH and private operators also provide advance payment as a part of co-operative marketing for short-term credit needs during the production period. The government loan programme often compensates

banks for the difference between commercial and subsidised interest rates. In the agricultural sector, NH is the main financial institution for delivering government loan programmes. While commercial banks have recently been allowed to participate in the government programmes, they accounted for only 0.8% of their value in 2015. The Agriculture, Forestry and Fisheries Credit Guarantee Fund (Nongshinbo) guarantees credit for bank loans of farmers and agricultural corporations. Nongshinbo can guarantee bank loans up to 20 times the value of underlying assets; this is financed by a guarantee fee charged to borrowers and contributions from government and financial institutions.[5]

Box 3.4. Farm debt issue in Korea

A foreign-exchange crisis in 1997 followed by an economic depression caused debt problems for capital-intensive farming. A Special Act was implemented to postpone due dates for repayment, to lower interest rates and to replace existing loans with cheaper ones. The Act alleviated the problems but revealed some limitations in resolving them fundamentally. For example, the Act was only applied to impending repayment schedules, thus requiring additional revision for subsequent schedules. From 2003, the government introduced a Business Revitalization Fund programme, operated by the NH, to help farmers with temporary crisis management, which provided low cost loans to qualified farmers all year around. However, the loans made by the fund showed a high default rate compared with other loans made by policy funds and/or mutual finance (Park et al., 2015).

In 2006, a Farmland Purchase Program to revitalise business (FPP) was established, whereby the Farmland Bank provides credit to farmers by purchasing their farmland, allowing the farmers repay the outstanding debts. Commercial banks (including NH Bank) cannot join this programme as only farmers or legally designated agricultural corporations can own farmland. Farmers have the right to rent the farmland for up to 10 years and to repurchase it at any time during the contract period.

Although subsidised loans and credit guarantees have been the main financial instruments in Korean agriculture to date, a direct financing channel is emerging. For example, in 2010, the investment partnership between the government and fund management companies established a fund of funds that invests in the agricultural sector. In 2016, licensed brokers with online platforms launched crowd funding for agriculture. The government also developed the legal framework to provide loans based on movable property such as livestock. In 2012, an act on security over movable property and receivables was enacted to resolve capital rationing pertaining to small and medium-sized businesses with a lack of real property. This allowed agricultural inventory, livestock and livestock products to be used as collateral for loans. For example, to help livestock farms 2015, NH expanded the types of collateral to include Korean native cattle, beef cattle, dairy cattle, broiler chickens and ducks. JB bank also provides loan secured by agricultural products, such as livestock, livestock products and rice within 80% of market valuation.

3.5. Tax policy

Tax policy affects innovation, productivity and sustainability in many ways: it affects the decision of firms and households to save or invest in physical and human capital, and thus the adoption of innovation; it raises government revenues, which can then finance public services, including those enabling innovation such as education and skills, R&D, and strategic infrastructure; it can also be used to provide direct incentives, for example

preferential tax treatment to investments in private R&D or to young innovative companies. In addition to its economy-wide impacts, tax policy influences the conduct, structure and behaviour of farm, input suppliers and food companies. Taxes on income, property and land and capital transfer, including land, may affect structural change, while differential tax rates on specific activities (polluting or environmentally friendly), resources, or input use may affect sustainability.

In Korea, the ratio of tax revenue to GDP, including social security contribution is around 25% as of 2015, which is below the OECD average of 34%. As of 2017, there are 14 national taxes and 11 local taxes. Income tax, VAT, and corporate income tax are by far the most important in terms of revenue. The total tax rate on enterprise in Korea was 33% in 2016, which is lower than that of most OECD countries (World Bank Group and PwC, 2017). Taxes on consumption account for 29% of tax revenue, which is lower than the OECD average of 34%. The share of local government in total tax revenue was 20.1%, excluding social security contributions, whereas its share in expenditure was much higher, at 63% in 2014 (Box 3.5). Expanding the tax base is another important policy agenda for Korea, including lowering the minimum income taxation threshold and decreasing – or in some cases eliminating – special tax treatments. This issue has significant relevance for agriculture, a sector that has enjoyed a considerable number of special tax treatments.

Box 3.5. The fiscal relationship between central and local government in Korea

Local governments depend heavily on grants from the central government. Their financial resources come mainly from local taxes, shared taxes, and earmarked grants. Revenue from local taxes accrues directly to the local government. The revenue of the shared taxes, which is 19.2% of all national taxes except customs tariffs, is allocated by a predesigned formula to provide the financial resources necessary to deliver basic public services. The discretionary powers of the central government over local and shared taxes are limited. In 2016, the combined share of local taxes and shared taxes in local government revenue was 74.2%.

Earmarked grants, which flow from the central to local governments, target political objectives considered important by the central government. Earmarked grants for many expenditure programmes are conditional on co-financing by the local governments. For example, 34 of MAFRA's 70 expenditure programmes of 2016 entailed co-financing for which local governments provided 40% of the total budget, or KRW 1.26 trillion (USD 1.09 billion) (MAFRA, 2016b).

A Special Tax for Rural Areas (STRD), whose revenue goes directly to a pre-designated government programme on rural development, was introduced in 1994. It is a surtax levied on the exempted amount of corporation tax, individual income tax, customs duty, individual consumption tax, and securities transaction tax. A special account for regional development (SARD) was established based on the STRD's revenue to allow the local governments more fiscal resources for their own policy initiatives. Unlike the subsidies which are linked to expenditure programmes designed by the central government, a part of the SARD resources can be utilised by the local governments as 'block grants' with more discretion so long as their expenditures conform to guidelines set by the central government. The principle of co-financing by the local government is also applied to all categories of SARD block grants, with co-financing ratios varying between 0% and 70%. As of 2016, there were five categories of block grants (for which the MAFRA set the guidelines in 2015), supporting the development of rural tourism, infrastructure for upland farming, regional industry, and basic living infrastructure (Ko, 2015).

Tax expenditure

The State Finance Act caps tax expenditure to 15% of the sum of central government tax revenue and tax expenditure, but the actual ratio of tax expenditure was 14.1% in 2015. In terms of revenue foregone, the VAT tax deduction for the purchase of agricultural products by the food processing businesses or restaurants is the largest tax expenditure programme. Tax expenditure on agriculture accounts for 13.4% of total expenditure in 2017, which is higher than the share of agriculture in budget expenditure (Table 3.2).[6] Tax expenditures account for 20% of total expenditure on agriculture, which is higher than for other policy areas, indicating the importance of tax relief as a policy measure to support the sector.

Table 3.2. Budget and tax expenditures in Korea, 2017

Trillion KRW, %

	Amount (A)	Share (%)	Amount (B)	Share (%)	A+B	Share (%)	B/(A+B) (%)
Agriculture[1]	19.6	4.9	4.9	13.4	24.5	5.6	20.0
Education	56.4	14.1	1.3	3.4	57.7	13.2	2.3
Social welfare	119.7	29.9	10.3	27.9	130.0	29.7	7.9
Others	205.0	51.1	20.5	55.3	225.5	51.5	9.1
Total	**400.7**	**100.0**	**37.0**	**100.0**	**437.7**	**100.0**	**8.5**

Note: 1. Forestry and fisheries included.
Source: National Assembly Budget Office (2016).

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Taxes on agricultural products and inputs

In Korea, the supply of unprocessed edible food is categorically exempted from VAT. The rationale for this exemption is to free the consumers from a tax burden on necessity goods. The same principle applies to water supply, briquettes, and women's sanitary pads. However, the exemption has positive production and income effects on agricultural producers as the benefit of non-taxation is shared between consumers and produces.[7] The special VAT treatments function as a means of supporting their income.

As the supply of unprocessed edible food is not taxable in the Korean VAT system, agricultural producers cannot get an input VAT deduction. Most inputs to agricultural production have a special treatment in the VAT system to remove this "unwanted" side-effect. Two important forms of the special treatment are the (*ex ante*) zero tax rate and the (ex post) VAT payment refund. The zero rate is applied to input items which are used exclusively for agricultural production such as fertilisers, chemicals for plant protection, agricultural machines, equipment and materials for livestock farming, and feed. For some specific equipment and materials that can be used for purposes other than agricultural production, a VAT refund is available when they have been used for agricultural production.

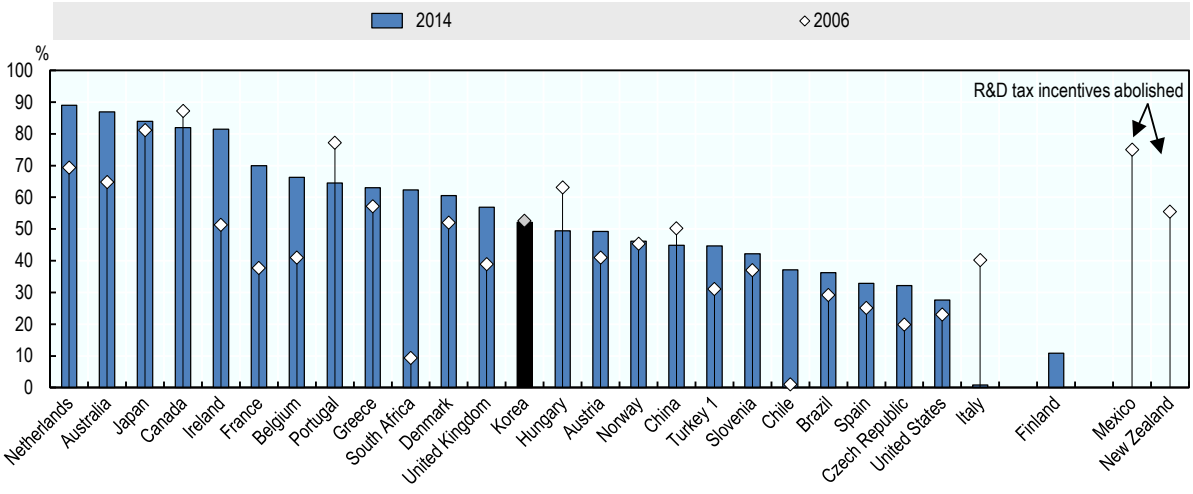
Another important tax treatment for agricultural inputs is the exemption of the taxes on oil fuels used for agricultural machines. In the Korean tax system, oil fuels used for agricultural machines, including tractors and heaters, are exempted from all fuel taxes; transportation-energy-environment tax, auto tax, individual consumption tax, education tax, and VAT.

Tax incentives to encourage innovation

Income tax or corporate income tax credit is given for a portion of expenses for R&D and human resource development. This tax credit is the third largest item in terms of foregone revenue. These expenses encompass salaries for R&D personnel, material costs for R&D, costs of outsourced training, and job capability development costs (Jeong, 2015). The credit ratio is higher if the taxpayer is a small or medium-sized enterprise or the expenses are made in specific businesses designated by the government as new growth-propelling sectors. Tax credit is also available for investment in facilities needed for R&D and human resource development. In terms of the relative importance of tax incentives in government funds for R&D, Korea has been in the higher ranking group among OECD countries (Figure 3.8).

Figure 3.8. Government support for business R&D through direct funding and tax incentives, 2006 and 2014

Tax incentive share of government funds for R&D



Note: For Turkey, 2006 is replaced by 2008.
Source: OECD (2017d), R&D Tax Incentive Indicators, http://oe.cd/rdtax; OECD (2017e), Main Science and Technology Indicators, www.oecd.org/sti/msti.htm.

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Tax credit is available for a firm's capital investment on condition that the number of permanent employees does not decrease. The credit to investment ratio is differentiated by sector, size of the firm, and the location of the investment (favouring SMEs and regions outside of the metropolitan area around Seoul). SMEs can claim special tax credit for investment in specific equipment or facilities essential to their business or computer software programmes. The credit-to-investment ratio of this treatment is 3%. Besides tax credit for investment, a partial tax exemption is available for SMEs. The exemption rate is differentiated from 5% to 30% by the size of the firm and its location. With foregone revenue of KRW 1.9 trillion (USD 1.64 billion), this credit is the fourth largest tax expenditure item.

Tax credit is also used as an incentive to encourage companies to adopt new technologies. It is available for investment in productivity-enhancing facilities, energy-saving facilities, and environment-preserving facilities. Another category of tax incentive to encourage the

adoption of innovation is special treatment for start-ups or investment in venture enterprises, e.g. tax credit or reduction, special treatments in collection procedures. Examples of such incentives include a tax reduction for new SMEs and venture enterprises for five years (50%) (KRW 145.4 billion - USD 125.2 million), tax incentives for investments in start-up investment companies, and tax exemption on gains from exercising the stock options of such companies.

Tax incentives to enhance sustainability

Korea provides tax credit for investment in environment-preserving facilities and energy-saving facilities, as well as zero-rating in VAT of equipment and materials for environment-friendly farming. Afforestation is promoted by a special treatment that reduces the personal or corporate income tax amount by 50% for income that is generated at least 10 years after afforestation. However, Korea's energy taxes do not sufficiently consider the environmental and other external costs of energy production and use across sector activities. For instance, in terms of both energy content and carbon content, the gap between the taxation of transport fuels and that of non-transport fuels is above the OECD average (OECD, 2013). Payment for energy also varies by user group, with tax rates highest for households, followed by industry, and agriculture enjoying exemptions. Environmental tax and charge rates on air pollution, water pollution and use, and land development are too low to cover environmental and social externalities or to encourage pollution reduction and efficient resource use. Furthermore, nitrogen oxide emissions from industry are not subject to the air pollution tax despite the fact that they are increasing (OECD, 2017b).

Unlike some OECD countries, Korea is not adopting an explicit carbon tax system. OECD (2016c) calculated 'effective carbon rates', in the determination of which tax systems play an important role. Korea is in the middle-low range among 41 OECD and selected partner countries in both road and non-road sectors. Except for residential and commercial uses, its proportion of CO_2 emissions priced above EUR 30 per tonne is lower in comparison to other larger OECD countries.

3.6. Summary

Korea has one of the most favourable macroeconomic environments among the OECD countries, with the fastest growth rate of per capita income over the past 25 years. The Korean economy is highly dependent on exports, which account for more than half of GDP. Reflecting the critical role of trade, Korea maintains a relatively open trade environment and has been actively pursuing bilateral and regional trade agreements. It also took a number of steps to liberalise foreign direct investment. However, agriculture is one of the few sectors receiving border protection, and foreign direct investment in some of the agricultural sectors is still restricted.

Enforcement of fair competition has been a policy issue in Korea, particularly because the economy is dominated by a small number of conglomerate business groups. Ensuring fair competition in input and output markets is a key area of policy to improve the agricultural sector's competitiveness. Korea's agricultural co-operative (NH) has been playing a major role in supplying farm inputs and finance, particularly for small scale producers. The government has been providing preferential tax and regulatory treatments to NH and used them as a channel of subsidised credit. However, as farm structure has diversified, high market shares of NH in supply of certain inputs (e.g. fertiliser) and financial services may hinder the entry of other players who can address the diverse needs of commercial farms.

Korea has developed relatively well-functioning financial markets and farmers can have access to various sources of finance, including through emerging direct financing. The government has also been providing low cost loans through NH. Although a government programme allowed small-scale producers to invest in farm equipment and land, it may have led to over-investment, constraining productivity improvement at the farm level and causing a structural farm debt problem after the financial crisis of the late 1990s.

Korea imposes a relatively low tax rate on enterprise, which has proved a favourable environment for corporate activity. It also provides tax incentives to encourage investment, in particular in R&D. The tax incentive for R&D in Korea is higher than in the majority of OECD countries. Preferential tax treatment plays a larger role in agriculture. For example, primary agricultural products are categorically exempted from VAT, and agricultural inputs including fertiliser, plant protection, farm machine and feed receive either a zero VAT tax rate or a VAT refund. Fuel taxes are exempted for farm machines. However, such special treatments may encourage the use of potentially environmentally harmful inputs such inorganic fertiliser, chemicals and fuels. The consistency with other policies to promote sustainability of agriculture, such as support to energy-efficient facilities, can be improved. Moreover, it may discourage appropriate financial management to record revenue and expenditure.

Korea has strengthened its environmental regulations and the stringency of its environmental policy is above the OECD average. The general environmental regulation system in Korea evolved from direct controls or command-and-controls in the 1980s to a combination of direct control and incentive systems since the early 1990s. Currently there is no environmental regulation imposed specifically on agricultural production, except for the regulations on livestock manure. Most of the regulations in the agricultural sector are on products and processes such as food safety, labelling of origin, and traceability. A comprehensive approach including regulation, incentives to invest in developing new technology, capacity-building and building partnerships between stakeholders is necessary to tackle growing livestock manure and disease management.

Designing agri-environmental policy requires the definition of reference levels and environmental targets, which play a crucial role in choosing policy instruments. Reference levels are the minimum levels of environmental quality that farmers are required to provide at their own expense, while environmental targets are a voluntary (desired) level of environmental quality. To establish a solid framework of agri-environmental policies, Korea should clarify the reference environmental quality as well as environmental targets which are well adapted to the local ecological conditions.

Notes

[1] The National Assembly can of course "create" new budget items or increase budget expenditure by enacting laws. However, once the budget proposal is submitted by the government to the National Assembly, the stipulation of the Article of 57 of the Constitution binds.

[2] The food industry is not an exception. Both the Lotte Group and CJ Group can be considered as *chaebol* and the sum of their market share in the Korean food industry is about 26.4%.

[3] The regulations on water resources and land use are reviewed in Chapter 4.

[4] Kwon et al. (2017) estimated the impacts of introducing mitigating steps of improving irrigation method, feed quality, and livestock manure treatment using a large scale applied general equilibrium model. They found that the marginal abatement cost of agricultural source GHG is about KRW 10 000 (USD 8.6) per tonne of CO_2 when those strategies are introduced, which is almost half of the average trading price of Korean ETS.

[5] Nongshinbo reported a guarantee balance of KRW 11 120 billion (USD 9 829 million) with underlying assets of KRW 2 250 billion (USD 1 988 million) in 2015.

[6] Important special tax treatments for agriculture are: the zero VAT rate for agricultural inputs (KRW 2.5 trillion USD 2.16 billion), the tax exemption for fuel oil used for agricultural production (KRW 0.9 trillion USD 0.78 billion), special treatment of capital gains tax on self-cultivated agricultural land (KRW 0.8 trillion USD 0.69 billion), and a tax favour on agricultural cooperatives' investments and deposits (KRW 0.7 trillion USD 0.6 billion).

[7] As a consequence, food processing businesses or restaurants are allowed the aforementioned estimated input VAT deduction for the purchase of agricultural products. Without the estimated input VAT deduction, they would be unable to get the input VAT deduction because agricultural producers are not VAT-registered.

References

Bae, C.W., Kim, J.G., Keum, H.Y. and Jang, Y.J. (2012), "Impact of Free Trade Agreement on Economic Performance in Korea", *KIEP Research Paper* No. 12-03, Korea.

Botta, E. and T. Koźluk (2014), "Measuring Environmental Policy Stringency in OECD Countries: A Composite Index Approach", *OECD Economics Department Working Papers*, No. 1177, OECD.

Choi, B.S. (2007), "The Status and Tasks of Legal and Policy Response to Soil Pollution," *Environmental Law Review*, 29(1): 391-420.

Civic Consulting and Ifo Institute (2017), Evaluation of the Implementation of the Free Trade Agreement between the EU and Its Member States and the Republic of Korea. Interim Technical Report Part 1: Synthesis Report, June 2017.

Consumer Safety Center (2014), Suggestion about Korean GMO Food Labelling System.

International Carbon Action Partnership (2017), Korea Emissions Trading Scheme, ETS Detailed Information.

Jeong, H K., and C.G. Kim (2015), "Goals and Strategies to Reduce Greenhouse Gas Emissions in the Agriculture Sector", *Agri-Policy Focus* No.115, Korea Rural Economic Institute.

Ji, I.B., B J. Woo, H.J. Kim, H. W. Lee, B.H. Han, S.M. Jeong, J.S. Joo, Y.J. Sin, and S.N. Lee (2016), White Paper of 2014-2016 Foot-and-Mouth Disease, Korean Rural Economic Institute.

Jones, R. and M. Kim (2014), "Promoting the Financing of SMEs and Start-Ups in Korea", *OECD Economic Department Working Papers*, No. 1162, OECD Publishing, Paris.

Jung, Y.T., Kang, C.K. and Lee, D.Y. 2013. New Growth Estimates and Re-evaluation of Korean Economy's Growth Drivers. The Bank of Korea Issue Note No. 2013-3, Seoul.

Kim, C. G. (2009), *Strategies of Agricultural Sector in the Five-Year Plan for Green Growth,* Korea Rural Economic Institute.

Ko, G. (2015) "History of changes of Special Account for Rural Development and its Reform Direction", a report of Future Politics Centre

Korea Environment Institute (2004), *A Study on the Correlation between Environmental Regulation and Industrial Competitiveness*.

KREI (2015a), *2015 Agriculture in Korea*, Naju, Korea: KREI.

KREI (2015b), Direction for Introducing Total Maximum Nutrient Loading System of Cultivated Land.

Kwon, O. S. (2013), *Environmental economics*, Pakyoungsa.

Kwon, O. S., D. K. Lee, K. B. Kwon, M. J. Han, Y. Suh, and H. B. Lee (2013), A Study on the Policy Issues for Conservation and Management of Multifunctional Rural Resources, Ministry of Agriculture, Food and Rural Affairs and Korea Rural Community Corporation.

MAFRA (2016a), *2016 Plan to Select a Company for Conversion Livestock Manure into Public Resource (Announcement).*

MAFRA (2016b), "Guideline for Expenditure Programs for Agriculture, Forestry, Livestock holding, and Food Industry" Ministry of Agriculture, Food and Rural Affairs, Korea.

MAFRA (2014a), *Rural Proofing on Welfare Policy for Persons with Disabilities and Waste Management Policy and the Follow-up Assessment of 2011-2012 Rural Proofing.*

MAFRA (2014b), *An analysis of the Potential to Reduce Greenhouse Gas Emission in Agrifood Sector and Strategies to Achieve the Reduction Goal.*

MAFRA (2012), Climate Change Impacts and Response Plans in Food, Agriculture, Forestry and Fisheries.

Ministry of Environment (ME) (2016a), 2016 White Paper of Environment.

ME (2016b), *Industrial Wastewater Generation and Treatment*.

ME (2016c), *Management of Authorization and Permission for Air Pollutants Discharge Facilities*.

ME (2011), *Research on Economic Analysis and Improvement Measures for Installation and Management through the Assessment of Different Livestock Excreta Disposal Facility Types*.

National Assembly Budget Office (2016), "Analysis of the Tax Expenditure Budget 2017".

OECD (2017a), "OECD FDI Regulatory Restrictiveness Index", OECD FDI Statistics (database), http://www.oecd.org/investment/fdiindex.htm.

OECD (2017b), *OECD Environmental Performance Reviews: Korea 2017*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264268265-en.

OECD (2017c), "Case study in livestock disease management: Korea", in *Producer Incentives in Livestock Disease Management*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264279483-10-en.

OECD (2017d), R&D Tax Incentive Indicators, http://oe.cd/rdtax.

OECD (2017e), Main Science and Technology Indicators, www.oecd.org/sti/msti.htm.

OECD (2016a), *OECD Economic Surveys: Korea 2016*, OECD Publishing, Paris, https://doi.org/10.1787/eco_surveys-kor-2016-en.

OECD (2016b), *OECD Economic Outlook*, *Volume 2016 Issue 2*, OECD Publishing, Paris, https://doi.org/10.1787/eco_outlook-v2016-2-en.

OECD (2016c), *Effective Carbon Rates: Pricing CO_2 through Taxes and Emissions Trading Systems*, OECD Publishing, Paris, https://doi.org/10.1787/9789264260115-en.

OECD (2015a), *Government at a Glance 2015*, OECD Publishing, Paris, http://dx.doi.org/10.1787/gov_glance-2015-en.

OECD (2015b) "Korea", in *OECD Regulatory Policy Outlook 2015*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264238770-30-en.

OECD (2015c), Trade Facilitation Indicators, http://www.oecd.org/trade/facilitation/indicators.htm.

OECD (2014), OECD Product Market Regulation Database.

OECD (2013), *Taxing Energy Use: A Graphical Analysis*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264183933-en.

OECD (2007), *OECD Reviews of Regulatory Reform: Korea*, OECD Publishing, Paris, https://www.oecd.org/korea/41399033.pdf.

Park, J.K. et al. (2015), "A Study on the Farm Management Stabilization Support System: Current Situation and Policy Implications", Korea Rural Economic Institute.

United States International Trade Commission (USITC) (2016), "Economic Impacts of Trade Agreement Implemented under Trade Authorities Procedures, 2016 Report", Publication No. 4614, Washington DC, June 2016.

World Bank (2017), "Doing Business 2017: Equal Opportunity for All", World Bank.

World Bank Group and PwC (2017), *Paying Taxes 2017: The global picture*, World Bank Group and PwC.

World Economic Forum (2016), "The Global Competitiveness Report 2016-2017: Full data Edition", Geneva 2016 http://www3.weforum.org/docs/GCR2016-2017/05FullReport/TheGlobalCompetitivenessReport2016-2017_FINAL.pdf.

WTO (2016), *Trade Policy Review: Korea*, World Trade Organization, Geneva.

Chapter 4. Capacity building and public services in Korea

Capacity building, including provision of essential public services, is one of the main channels or incentive areas to support innovation and sustainable development. This chapter concerns four relevant policy areas: infrastructure and rural development policy; land use planning and regulation, water policy; labour market policy; and education and skills policy.

4.1. Infrastructure and rural development policies

Investments in physical and knowledge infrastructure, from ICT to transportation facilities, are important for overall growth and development. They are vital to the delivery of and access to important services and play a critical role in linking farmers and related businesses to markets, reducing food waste, boosting agriculture productivity, raising profits, and encouraging investment in innovative techniques and products. Productive and profitable enterprises may have higher incentives to invest in sustainable practices that yield long-term benefits.

Broader rural development measures also affect sustainable agricultural development and structural adjustment. Increased off-farm income and employment opportunities mitigate farm household income risks, facilitate farm investment, and enable a wider range of farm production choices. Improved rural services, from banking to ICT, are important to ensure needed connectivity to suppliers, customers, and collaborators. Rural policy can also attract innovative upstream and downstream industries, with possible spill-over effects locally. By reducing inequalities in economic development and access to services across regions, rural development policies improve the diffusion of innovation.

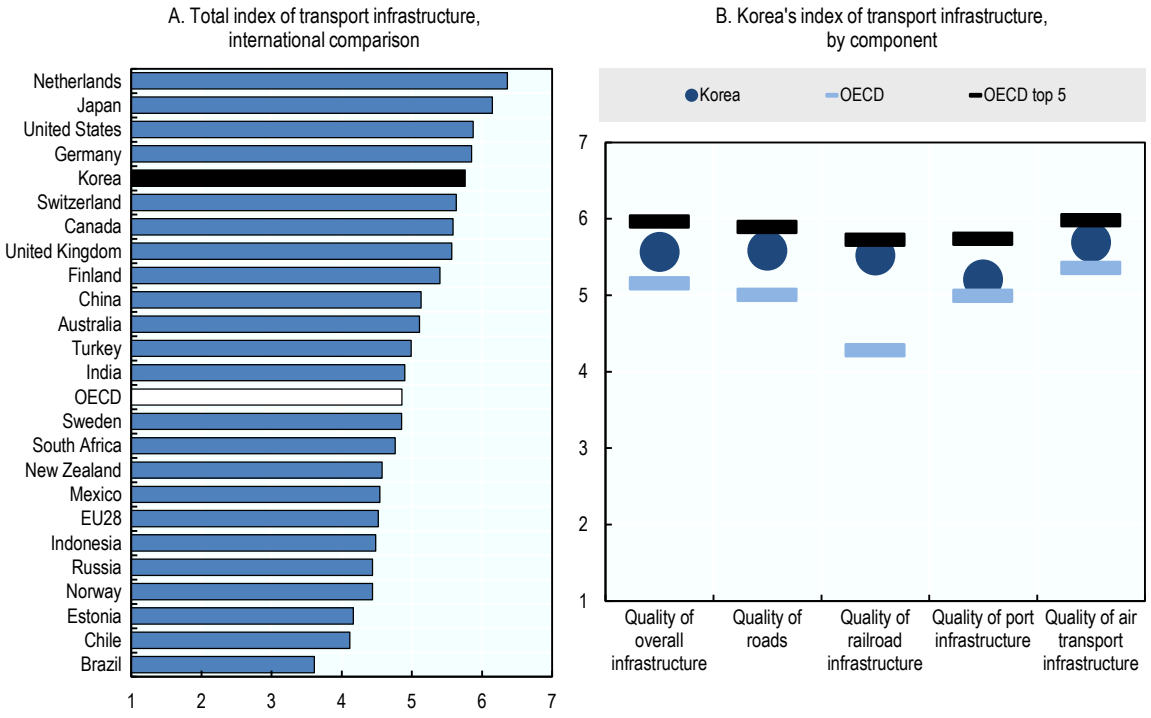
Infrastructure development

Korea has developed a high-quality transport infrastructure, reflecting the continuous efforts to expand infrastructure since the 1970s. According to the Global Competitiveness Index on the quality of transport infrastructure, Korea ranked 7th among the OECD countries and 10th globally (Figure 4.1). In 2017, the government spent KRW 22.1 trillion (USD 19 billion) for Social Overhead Capital (SOC) investment, which accounts for 5.5% of total expenditure.[1] The investment in roads and railway has the highest shares in public investment: 33.4% and 31.2%, respectively. According to the National Fiscal Operation Plan 2016-2020, the government is planning on gradually reducing SOC investment as spending on the welfare sector increases as the stock of SOC has already reached the level of developed countries.

Though responsible for building and maintaining public infrastructure, the government is encouraging private investment in infrastructure. To this end, it has drawn up the Master Plan for Public-Private Partnerships in Infrastructure as a guideline for Public-Private Partnership projects. These projects can be classified into two groups: Build-Transfer-Operate (BTO) and Build-Transfer-Lease (BTL). The BTO mode is mainly for traffic facilities such as roads, railways and ports, while the BTL mode is mainly for education, welfare, culture, medical facilities and environmental facilities. The size of infrastructure investment through the Public-Private Partnership was KRW 2.7 trillion (USD 2.3 billion) in 2016.

Figure 4.1. Global Competitiveness Index: Quality of transport infrastructure, 2015-16

Scale from 1 (worst) to 7 (best)



Note: Indices for EU28 and OECD are the simple average of member-country indices. OECD top 5 refers to the average of the scores for the top five performers among OECD countries (the Netherlands, Japan, France, the United States and Germany).
Source: World Economic Forum (2016), The Global Competitiveness Report 2016-2017: Full data Edition, Geneva 2016. www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1.

StatLink https://doi.org/10.1787/888933851761

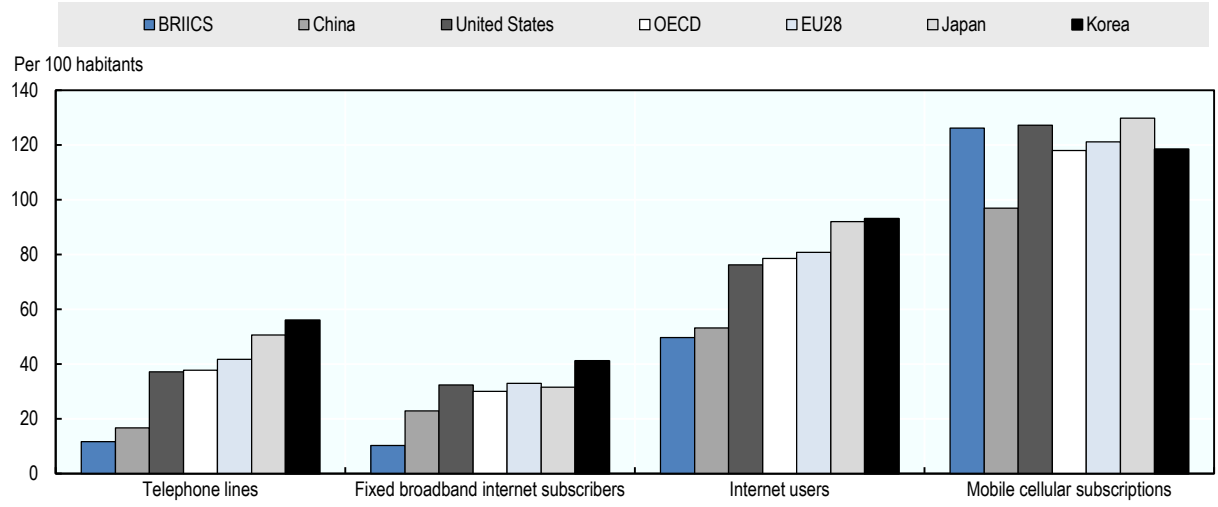
ICT development in rural areas and application to agriculture

ICT penetration such as fixed broadband internet subscription and internet use is particularly high in Korea (Figure 4.2). The Ministry of the Interior and Safety has been implementing the Information Network Village Project to promote high-speed internet access in rural areas, expanding the number of participating villages from 25 to 359 between 2001 and 2013. The project reduced the digital divide between urban and rural areas. By 2016, the penetration rate of the broadband network in rural areas increased to 92.8% (KREI, 2016), while 23.2% of farm households were using computers and smartphones in agricultural production (KOSTAT, 2016a).

A high-level ICT infrastructure has the potential to increase agricultural productivity by reducing costs in the production process and mitigating volatility caused by natural environmental conditions. MAFRA is promoting the Smart Agriculture project to integrate ICT with agriculture and rural areas. This project established more than 45 cases of model development and field demonstration. The area of greenhouse vegetable production using ICT expanded from 40 077 to 52 526 ha between 1995 and 2015. The project also introduced an automatic feeding system for pig farms. To promote effective integration of ICT with the agri-food industry, the Korean government is developing farming systems

where artificial intelligence (AI)-based systems automatically control farm operation; it is also enhancing the use of drone technology and geographic information systems (GIS).

Figure 4.2. ICT penetration, 2016



Source: World Bank (2017), World Development Indicators (database), https://data.worldbank.org/products/wdi (accessed 4 October 2017).

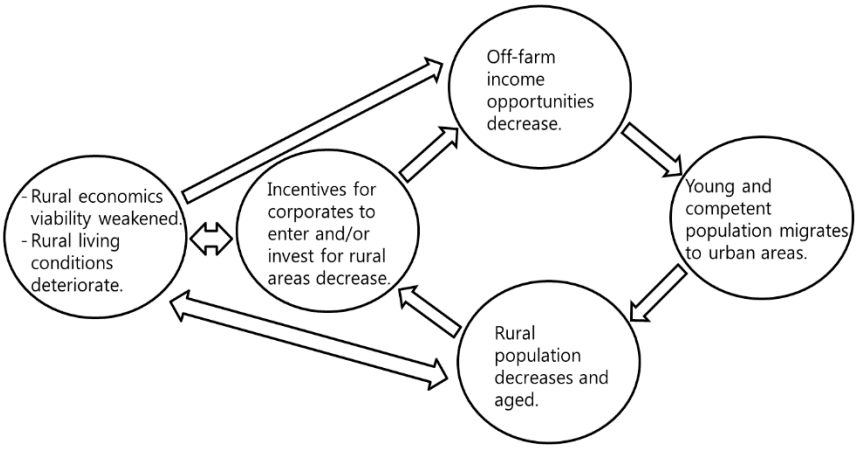
StatLink https://doi.org/10.1787/888933851780

Rural development policy

Balanced regional development has been a major policy issue in Korea, whose economic growth has concentrated on urban areas and the manufacturing sector, increasing the income gap between rural and urban households. Younger generations continue to leave rural areas for more lucrative opportunities in urban ones, accelerating the ageing of the rural population. Non-farm industries also have less incentive to relocate to rural areas, reducing off-farm income opportunities (Figure 4.3).

Rural development policy in Korea evolved from participatory community-based programmes in the 1950s to nation-wide comprehensive programmes, widening the scope from agriculture to non-agricultural industries (). The government enacted the Special Act on Improving the Quality of Life in Rural Areas and Rural Development Promotion in 2004 to attract human resources and economic activity to rural areas. In 2016, investment and financing were focused on projects such as revitalisation of rural hubs, village maintenance, housing maintenance, water use improvement, and safety management of rural areas. The National Standards for Rural Area Services set a concrete policy target in 2010 to guarantee a high quality of life for rural residents by 2019. The 2016 assessment of policy achievement shows that most areas still fell short of the standards, except for emergency services and the broadband convergence network (Table 4.1). For example, the nationwide water supply ratio at the rural district was 69.3% in 2016, while the target in 2019 is 82%.

Figure 4.3. Korean rural circular and cumulative vicious cycle



Source: Modified from Hodge and Whitby (1981).

The promotion of non-farm industry in rural areas has been a major policy objective since the 1980s, with the government promoting the construction of industrial complexes there. By the end of 2015, 420 rural industry complexes were constructed, providing 150 000 jobs in agricultural product processing as well as other manufacturing industries (MAFRA, 2016a). Special tax treatment is one of the main policy incentives to relocate firms to rural industry complexes. Firms that locate in rural industrial complexes benefit from a 50% reduction of personal or corporate income tax for five years, starting from the first year the business has positive income since locating there.

As a part of the income diversification strategy, the so-called "6th industrialisation policy" has been implemented to promote the production of high-value-added agricultural products through expansion of farm operations to processing, marketing and tourism.[2] Since 2014, the government has installed 6th industrialisation support centres in 10 regions to investigate the development of 6th industrialisation activities and undertake business support projects. The government also established the 1st Basic Plan for the Development of the 6th industrialisation (2016-20) and introduced the certification system of 6th for business operators with a potential to lead the process and to foster outstanding enterprises. In 2016, 1 130 business operators received the certificate.[3] The Basic Plan has a target to maintain the sales growth rate of certified business operators at 5% by 2020, to increase the number of 6th industrialisation start-ups from 1 600 in 2016 to 3 000 in 2020, and to increase the number of rural tourism visitors from 6 million to 8 million during the same period.

Table 4.1. National standards for rural area services in Korea

Sector	Policy Target by 2019	2016[2] (%)
Health/welfare		
Medical service	City and county ratio to receive medical care for important subjects (such as internal medicine, oriental medicine, orthopaedics, obstetrics and gynaecology) should be 80% or more.	73.9
Emergency service	In case of an emergency, the rate that the ambulance will arrive within 30 minutes and receive first aid service should be 97% or more. In the case of the island area, a system of patient transport using helicopters and ships should be established.	98.6
The aged	The rate that elderly people can receive welfare services at home more than once a week should be 80% or more.	70.1
Young children	The rate to use day care facilities for infants and toddlers within *eup* and *myeon* districts should be 80% or more.	69.2
Education		
Elementary/middle school	Foster rural schools for local conditions and provide appropriate transportation to students who need transportation assistance.	71.8
Lifelong education	The rate to receive lifelong education programmes at the service centre facilities within *eup* and *myeon* districts should be 40% or more.	19.7
Settlement conditions		
House	The percentage of households living in homes that meet minimum housing standards should be 95% or more.	88.3
Water supply	Water supply ratio in *myeon* districts should be 82% or more.	69.3
Heating	City gas supply rate in e*up* districts should be 65% or more. The government should promote a reduction in heating costs in regions where it is difficult to supply city gas.	57.0
Public transportation	Use transport more than 3 times a day within the village. Quasi-transportation programmes should be introduced to regions where it is difficult to operate transportation system. In case of island areas, more than one round-trip passenger ship should be operated per day.	90.4
Broadband convergence network	Broadband convergence network construction rate should be 90% or more.	92.8
Economic activity/job		
Start-up and employment consulting/education	Professional consulting and education service about start-ups and employment should be available within cities and counties.	67.4
Culture/leisure		
Cultural facilities and programmes	It is possible to see a culture programme more than once a month and professional performance programme more than once a quarter in cultural facilities such as Culture and Arts Centre within cities and counties.	92.0
Environment/landscape		
Sewerage	The diffusion rate of sewerage should be 85% or more.	81.0
Safety		
Crime prevention equipment	CCTV installation rate should be 85% or more to prevent prevention of crime.	43.2
Police patrol	Patrols in villages vulnerable to crime should be conducted more than once a day for each village.	N/A
Fire call	The rate that a fire truck arrives at the scene within 5 minutes after receiving a report should be at least 55%.	41.1

Notes: 1. In Korea, *dong* districts are termed urban areas while *eup* and *myeon* districts are classified as rural areas.
2. 2016 indicates the year of publication using most recent data available.
Source: KREI (2016) Monitoring and assessment on the implementation of rural area service standard.

Box 4.1. History of the rural development policy in Korea

Korea's rural development policy began with community development movements in the late 1950s to overcome absolute poverty and increase agricultural productivity in rural areas. The community development programmes focused on the agricultural extension service and improvement of the residential environment. The Saemaeul (new village) Movement, widely cited as the model for rural development in developing countries, began in the 1970s. The Movement was implemented as a nationwide comprehensive development project, including improvement in rural infrastructure and residential environment as well as income generation activities such as the introduction of cash crop production and building factories. An important aspect of the Saemaeul Movement was co-operation between the government and rural residents through both the government budget and private funds.

In the 1980s, rural development policy shifted to a more state-led comprehensive rural development framework. Increased government budgets in the 1980s and 1990s enabled the central government to develop roads, communication facilities and water sources in rural areas, and to improve educational, medical and welfare systems. The major goals of the rural development policy during this period were to improve the living conditions in rural areas and to increase the rural income through creation of off-farm activities. The Act on Promoting the Development of Income Sources for Agricultural and Fishing Villages in 1983 promoted policies for Rural Industrial Complexes and rural tourism.

In the 2000s, the paradigm of the rural development policy was extended from agricultural production to settlement and recreation. The government focused on enhancing the amenity function of rural areas, boosting environmental protection and emphasising agriculture's role for preservation of the national land. The government has promoted an autonomous development strategy that strengthens local competencies and utilises local resources through projects. In 2005, the Special Account for Balanced National Development was established to reduce imbalances among regions. In 2010, this account was transformed to the Special Account for Metropolitan and Regional Development, converting a project-based budget support method to a region-based budget support. In this process, 210 existing regional development projects were merged into 24 comprehensive projects and the autonomy of local governments increased.

4.2. Land policy

Korea's farmland policy is rooted in the post-war farmland reform in 1950 which introduced the land-to-the-tillers principle and reallocated farmland to small-size tenant farmers. As the competitiveness of the agricultural sector became a major policy issue, the objective of farmland policy has evolved from promoting owner farming to consolidation of farmland to larger size units (Box 4.2).

Box 4.2. Evolution of farmland regulation in Korea

Korea's farmland regulation is based on the land-to-the-tillers principle originated from the farmland reforms in 1950. Based on the principles of owner farming, the Farmland Act explicitly states that farmland cannot be owned by anyone other than those who use it or intend to use it for farming by his or her own self. The Act also adopts an acquisition qualification system for farmland that authorises only eligible applicants. The farmland reform created owner farmers by buying the farmlands from landlords and distributing farmland to actual cultivators, imposing a maximum limit of farmland ownership to 3 ha. This maximum limit of land ownership existed until 2002. In 2003, the deregulation allowed non-farmers to own land of less than 1 000m2 for the purpose of hobby farming.

The corporate ownership of farmland was not allowed under the original Farmland Act. In 1990, the law introduced an agricultural corporation system to allow corporate ownership of farmland on the condition that all members of the corporation be farmers. In 2009, the membership condition for agricultural corporations was relaxed so that non-farmers can own less than half of the shares. Since 2011, the required share of farmer's investment was reduced to 10%, as was the restriction on executive members. Currently, agricultural corporations can be categorised into two types: farming corporations and agricultural company corporations. A farming corporation can be established by farmers and an agriculture-related producers' organisation with a minimum five members. Similarly, only a farmer or an agricultural producers' organisation can establish agricultural company, but non-farmers may invest up to 90% of the total investment if its value is less than KRW 8 billion (USD 6.9 million). If the total investment exceeds KRW 8 billion, non-farmers can invest the amount achieved by subtracting KRW 800 million (USD 700 000) from the total investment amount. Since the introduction of a farmland bank in 2005, non-farmers are also allowed to own a limited amount of farmland if they lease it from the bank on a long-term basis.

Promotion of land consolidation

Land leasing has become a major channel of land consolidation as a result of high land prices. The ratio of leased farmland has continuously increased from 17.8% in 1970 to 37.4% in 1990, 47.9% in 2010 and 50.9% in 2015. However, the Farmland Act allows leasing of farmland only in the exceptional case that the owner of the farmland changes due to migration or succession. Since 1990, the Korea Rural Community Corporation (KRC) has operated the Farm Scale Expansion Project, whereby farmers are provided with financial support for leasing and acquiring farmland through low interest loans, with a focus on young and full-time producers.[4] In 2005, the Farmland Act was revised so that KRC can perform the role of farmland bank that intermediates in the leasing of farmland. Farmland banks provide information to farmers who wish to own or rent farmland from the KRC or others who want to sell or lease farmland. The restriction on farmland leasing does not apply to long-term leasing of entrusted farmland from KRC, thereby allowing anyone to lease farmland. Under the farmland bank scheme, the lease period has to be more than five years, with annual rent determined in the agreement between the bank and the tenant. The bank deducts 5% of the rent and pays the remainder to the landlord.

Non-KRC land rental transactions are sometimes made without formal contracts. A tax incentive exists for land owners not to have a formal land lease contract (Box 4.3). The use of unstable contracts makes establishing long-term farming plans difficult, in particular for greenhouse farming or fruit farms, which require long-term investment. Additionally, land owners have an incentive to rent out land informally and still receive area-based payments, which should be paid to the actual cultivator. Chae, Gwang-seok et al. (2016) propose the

introduction of a Farm Land Lease Management Act and land lease reporting system to create an incentive for long-term investment in farmland.

Box 4.3. Special tax treatment for agricultural land in Korea

The government provides a number of special tax treatments for acquisition, ownership and transfer of farmland. A reduced rate of acquisition tax is applied when the farmland is acquired by a farmer on the condition it is used for agricultural production within two years. In 2010, this tax benefit also became available to 'non-farmer' rural residents who moved from urban areas three years or less before the acquisition; the aim being to assist the "returnees" in their settlement in the rural areas. While general property tax is imposed according to the value of land as well as other properties with a progressive tax rate (0.2%, 0.3%, and 0.5%), farmland that lies outside of urban areas is taxed with a flat rate of 0.07% if it is owned by a farmer.[1] Property tax is exempted if the land owner participates in the farmland pension programme on condition that farmland is used for agricultural production. Similarly, real estate tax on farmland is also partly or fully exempted from comprehensive real estate tax.

The capital gain from the sale of land is taxed separately from other income by a progressive system that has six different marginal rates between 6% and 40%, with a higher tax rate imposed if the land was owned for less than two years before the sale. However, a capital gain from the sale of farmland is exempted from the taxation if the owner lived near the land and used it for agricultural production for more than eight years.[2]

Another important special tax treatment for farmland is the exemption of gift tax, which is normally taxed progressively with five marginal tax rates (10%, 20%, 30%, 40%, and 50%). The gift tax is fully exempted if a farmer transfers farmland as a gift to a child who is a farmer. To be eligible, farmland must be near the parent farmer and have been cultivated for at least three years up to the time of the transfer. The child must use the land for agricultural production for at least five years, otherwise the child has to pay back the full amount of the exempted tax. The exemption of farmland from gift tax does not contribute to any increase of the tax base arising from another gift given later by the same person. This differs from the treatment of other properties, which are included in the gift tax base if they were transferred from the same person within ten years of the latest gift; by comparison, the exemption of farmland constitutes a significant favour. Concerning the inheritance of agricultural business, properties used for agricultural production, including farmland, are exempted from inheritance tax up to KRW 1.5 billion (USD 1.29 million) on the condition that both parties have been engaged in farming and the inheritor uses the land for agricultural production for at least five years after the inheritance.

Notes: 1. The value of property such as land parcels and houses are assessed and announced by the government every year by Act on Real Estate Price Announcement and Appraisal and Assessment. The assessment is, in principle, based on 'market value'. This would reflect the current use value of the property as well as the expectation on potential, alternative uses of the property.
2. This special treatment applied even if the land is used for non-agricultural purposes after the sale. However, if the land became included in a residential zone before the sale, the treatment applies only to the income that was generated until that inclusion.

Land conservation policy

During the period of Korea's rapid economic growth since the early 1970s, as the population grew and urbanisation and industrialisation progressed, significant amounts of farmland were converted to other uses, such as residential, commercial-industrial and public. In response, the government enacted the Farmland Preservation and Utilization Act in 1972 and strictly restricted the conversion of farmland for non-agricultural purposes.

The Act designated two types of farmland: absolute farmland, which needs to be strictly protected for agricultural production, and relative farmland, which is less suitable for agricultural production. Government permission is required to convert farmland and developers pay a fee to the Farmland Management Fund to make alternative land available for farming.

In 1992, to preserve the area of high-quality farmland, the plot-based farmland preservation system of designating absolute and relative farmland was replaced by a new system of designating good collectivised farmland as an agriculture promotion region (APR). Farmland within an APR has restrictions on land conversion as it formerly would under the absolute farmland system. Farmland conversion is restricted to installation and construction of agricultural facilities and social infrastructure to help preservation of the land. Farmland benefits from several measures, including improvement and maintenance of agricultural and agricultural facilities, expansion of agricultural roads and agricultural product distribution facilities, funding assistance and tax reduction. In 2015, the size of APR was 810 000 ha, accounting for 48% of total farmland. Despite the benefits, owners of farmland lack incentives to include their land in APR as it makes land conversion to non-agricultural use difficult, thereby reducing farmland price: the high price of farmland reflects its potential option value for future non-agricultural use.[5]

In addition to conversion to non-agricultural use, idle farmland contributed to the reduction of total farmland area from 2.298 million ha to 1.679 million ha between 1970 and 2015. In terms of farmland conversion by land type of use, government and public use accounts for the largest share, 38% in 2015, whereas the use for agricultural facilities represents only a small portion. On the other hand, the idle farmland area is three to four times larger than the converted farmland area. If farmland is not used for farming without justifiable reasons, the head of the local government can issue a disposal order to the idle farmland owner. If the owner cannot find a suitable buyer the idle farmland, they can request the KRC to purchase it.

4.3. Water policy

Sustainable productivity growth in agriculture requires a sufficient and stable quantity of usable freshwater for crops and livestock, and minimised impacts of agriculture activities on water resources. Water policies can support or hinder the capacity of the sector to reduce its impacts on water resources, increase its overall water use efficiency and its resilience to water risks.

Water governance

Water is an essential natural resource for all economic activities, including agricultural production. The characteristics of water make it difficult to manage effectively: its shape and location are not fixed, and its circulation on earth makes it difficult to specify water rights and to designate water management authorities. The potential conflict of interests among individuals, interest groups and even public agencies obliges the establishment of a good water governance system.

In Korea, the management of water and watersheds has been classified into two types of activities: water use and water control. Water use incorporates the activities of managing water quantity and quality, while water control implies the activities primarily related to water risk management (i.e., flood and drought control). For water use, Civil Law grants customary rights to the operators of farms or factories to withdraw certain amounts of water

from common rivers.[6] The water use right is not tied to land property rights, and the trading of rights or entitlements is not permitted. Meanwhile, the River Act requires that anyone who intends to use river water for domestic use, manufacturing, agriculture, environmental improvement, or shipping is required to obtain permission to do so. The Act allows the government to deny permission or restrict water withdrawal if there is a possibility of damaging ecosystems or the safety of water infrastructure.

The Constitution adopts the principle of nationalisation of water resources, which emphasises equity in water use. In the early stages of economic growth, the government developed water sources and managed rivers with an emphasis on storing water, constructing hydro-power generators and delineating rivers. In the 1980s, when the issue of water pollution arose, a sequence of laws for water quality management and environment-friendly river management was introduced. Although water management based on demand control has come under discussion as the private sector of the economy has grown, the government still remains the most influential player in water governance in Korea.

Responsibility for water management is divided among six ministries (although the allocation of roles is being discussed under the new government as of 2017): the Ministry of Land, Infrastructure, and Transport (MOLIT), the Ministry of Environment (ME), the Ministry of Agriculture, Food and Rural Affairs (MAFRA), the Ministry of Interior and Security (MOIS), the Ministry of Trade, Industry, and Energy (MOTIE), and the Ministry of Oceans and Fisheries (MOF). In addition to drawing up the comprehensive water development plan, MOLIT is in charge of water quantity and river management. It manages rivers and multi-purpose dams, and it develops metropolitan waterworks. MAFRA is in charge of managing agricultural water resources. ME is in charge of water quality and ecosystem management, and manages local waterworks in co-operation with local governments, which supply drinking water to the final consumers. The role of local governments is quite limited in overall water resource management.

Specialised public water companies play an important role in the management of water resources and supply of water to consumers. K-Water, a public company, is involved in all the duties of MOLIT. The company constructs, operates, and manages facilities for water resource development, constructs and manages metropolitan waterworks facilities, provides water to local waterworks, and so on. The agricultural water duties of MAFRA are implemented by KRC and the local governments. KRC constructs and operates irrigation facilities such as reservoirs, pumping stations, groundwater tube wells, and irrigation channels. Under the authority of ME, another public company, the Korea Environment Corporate (KECO), supports policy making and implementation for water, sewage and water quality management (OECD, 2017b). Local governments also usually establish a local public company to provide residents with tap water and sewage treatment services.

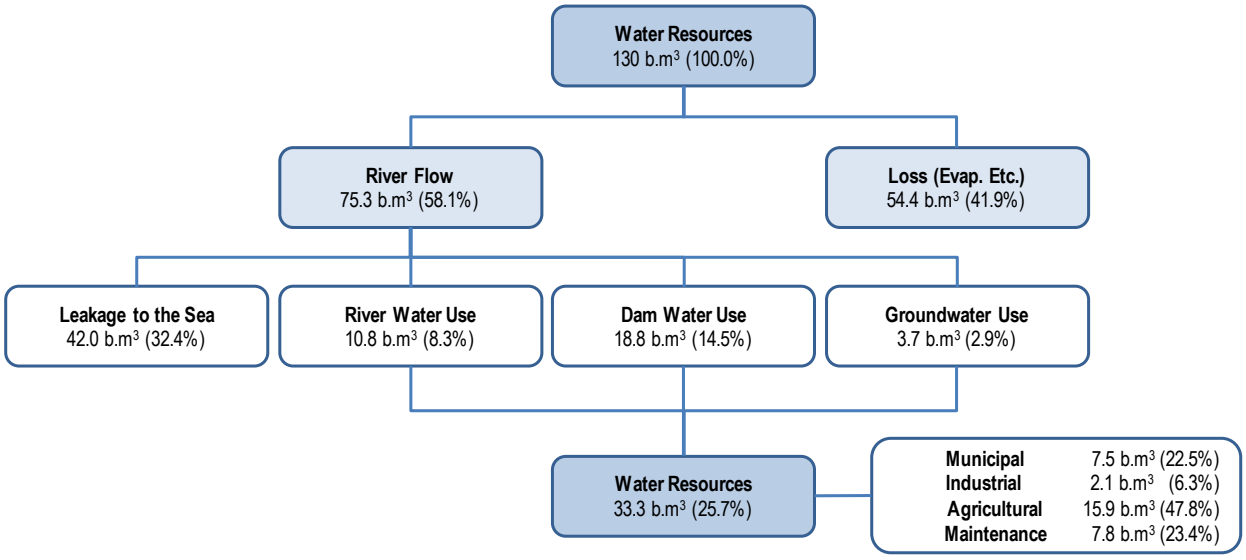
Figure 4.4 shows the water flow in Korea. Only 26% of total available water resources are used due to loss and the leakage to the seas. More than half of water used has to pass through dams, which store water for dry seasons. Agriculture accounts for just under half of water use, municipal water for 23%, and industrial use for 6%.

Recent water policy reviews noted insufficient co-ordination in and among the multiple ministry-level agencies which are in charge of particular aspects of water management (Lee, K., 2016; OECD, 2017b). To be effective, the management of water quality should be closely co-ordinated with that of water quantity. In the current system, those two duties are separately implemented by ME and MOLIT, respectively. Because multiple agencies

are participating in water management with different roles, it is more difficult to introduce structural changes in water management (Hong et al., 2006).

Kim (2016) also points out an ambiguity in the establishment of water rights. The Civil Act acknowledges a customary right of those who have been using water before the introduction of the permission system. The principle of allocating water to particular usages and regions is not clear enough. Because of this ambiguity, several disputes have arisen on water pricing and allocations (OECD, 2017b), especially between K-Water and the local governments.

Figure 4.4. Flow of water resource in Korea



Source: Ministry of Land, Infrastructure and Transport (2013), Water vision 2020.

Water pricing

Korea's water supply and sanitation charges are the lowest in the OECD. Charges related to water resource management are uniform across the country and so do not signal regional differences in water availability and risk. The low collection rates on certain taxes and charges, particularly related to water quality, suggest imperfect enforcement, which further weakens incentives for pollution reduction and efficient use (OECD, 2017d).

Korea has three different types of water prices; metropolitan water prices, local water prices, and irrigation water prices. Metropolitan water prices are applied when K-Water withdraws water from the rivers and dams that it manages and supplies this water to the local governments. The prices of water that the local governments supply are determined by the local councils, and they incorporate production costs. The local price clearly depends on the water resource availability, water infrastructure, geographic characteristics, market size, and other socio-economic conditions of the region (Kwon, 2009). In 2013, the highest local price was 3.6 times higher than the lowest local price (Kim, K., 2013). Moreover, the prices determined by the local councils do not cover the actual production costs; hence, the local governments record a substantial deficit in their water businesses. Low water prices induce overconsumption, indicated by far larger per capita water consumption in Korea than the OECD average (Kim, K., 2013). Currently, local water prices, which are

differentiated among usages, have the form of two-part tariffs: the price is composed of a fixed fee and a use price.

Farmers usually receive their irrigation water either from KRC or from their local government. In regions where KRC provides the irrigation water, no irrigation price is currently in place and the water is free. KRC meets its operating costs from two financial sources: a grant from MAFRA and revenue from sales of the company's assets. These assets include reservoirs and other facilities that farmers had previously financially contributed to building but which were taken over by KRC mostly in the late 1990s. Because of their historical contribution to KRC, farmers are considered to bear some of the irrigation costs. In regions where irrigation water is provided by the local government, farmers have to pay for the water, but the price is still very low compared to the production cost; hence, the local government also records a deficit in the irrigation water business (Kim et al., 2014).

The full cost of water is the sum of supply cost (capital cost, and operation and maintenance cost), opportunity cost, and externality cost (OECD, 2010a). Although comparing agricultural water charges among countries requires considerable caution, the agricultural water charge in Korea does not recover even the direct supply cost. There are concerns that full-cost-recovery pricing for water in agriculture would penalise low-income farm households relative to urban workers.

Providing water, especially irrigation water, may become more costly in the future because of climate change, increased competition to access the resource (driven by economic development and urbanisation), degraded water quality and limited capacity to build more dams. In this context, an increase in water charges to at least reflect full supply costs (and ideally cover the opportunity cost of water withdrawals) would help agriculture to adapt to these future constraints (Table 4.2). In return, social and adjustment policies could be used to compensate the poorest farmers or to facilitate necessary consolidation in the affected sectors (OECD, 2016a). Prioritising targeted actions at the subnational level, via the identification of hotspots, may help increase efficiency and effectiveness of policy responses if water risks differ in different part of the country (OECD, 2017c).

Table 4.2. Full supply cost recovery[1] for surface water delivered on-farm across OECD countries[2], 2008

100% cost recovery of Operation and Maintenance and Capital Costs:
Austria; Denmark; Finland; New Zealand; Sweden; United Kingdom
100% cost recovery of Operation and Maintenance Costs, but less than 100% recovery of Capital Costs:
Australia; Canada; France; Japan; United States
Less than 100% cost recovery of Operation and Maintenance and Capital Costs:
Greece; Hungary; Ireland; Italy; Mexico; Netherlands; Poland; Portugal; Spain; Switzerland; Turkey
Less than 100% cost recovery of Operation and Maintenance Costs, with Capital Costs supported:
Korea
Recovery of other costs through water charges or water pricing: Opportunity costs, economic and environmental externality costs:[3]
Australia, some environmental costs already recovered, but planned to recover opportunity costs;
Australia, some environmental costs already recovered, but planned to recover opportunity costs; economic and environmental costs by 2010;
France, is recovering a share of the environmental costs through water charges;
United Kingdom, currently recovering share of environmental costs.

Notes: 1. The full supply costs include operation and maintenance costs and capital costs (renewal and new costs).
2. No information is available on the following OECD countries: Belgium, Czech Republic, Germany, Iceland, Luxembourg, Norway, Slovak Republic.
3. Other costs including opportunity costs, economic externality costs constitute the 'full economic cost' with the full supply costs, which make up 'full cost' with environmental externality costs.
Source: OECD (2010b), *Sustainable Management of Water Resources in Agriculture*, p.91.

Water quality management

Water quality control is one of the main objectives of the national environmental control. Managing industrial sewage and implementing the Total Maximum Daily Load Management System (TMDL) are the two main policy instruments for pursuing the policy goals. Water quality standards are imposed on rivers, lakes and marshes, and groundwater.[7] For rivers, lakes and marshes, the Health Protection Standards are imposed on 20 common substances. Another group, the Living Environment Standards, is imposed on nine substances for rivers and ten substances for lakes and marshes. For groundwater, there are standards on five toxic substances and four general substances.

The water quality of public rivers and lakes is monitored by ME through its network of water quality monitoring stations (ME, 2017a). The monitoring is conducted by two research institutes, the National Institute of Environmental Research and the Public Health and Environment Research Institute, and KRC. The Water Quality Monitoring Network tracks about 40 water measures, including water temperature, pH, BOD (Biochemical Oxygen Demand), and COD (Chemical Oxygen Demand). It also measures sediments and radioactive materials. Each item is measured at different intervals, from once a week to once a year. The measurements are published in the Environmental Statistics Yearbook.

KRC monitors the agricultural water quality of 975 stations quarterly. In every other year, 17 000 reservoirs and artificial lakes are inspected. The water sources and facilities whose water quality does not satisfy the quality standards are classified as focus objects requiring intensive quality management. Table 4.3 shows that the majority of agricultural water quality indicators measured at 825 sites in 2014 are "Slightly Good," "Normal," or "Slightly Bad". Use of agricultural water is approved if its quality is no worse than "Slightly Bad". Municipal sewage, livestock manure, and land use effluents were the three main sources of agricultural water pollution.

Table 4.3. Agricultural water quality measurement in Korea, 2014

	Number	Ratio (%)
Water quality grade		
Very good	3	0.4
Good	64	7.8
Slightly good	162	19.6
Normal	165	20.0
Slightly bad	257	31.2
Bad	93	11.3
Very bad	81	9.8
Total	**825**	**100.0**
Main pollutant sources		
Municipal	233	28.2
Livestock manure	223	27.0
Land	363	44.0
Industry	2	0.2
Aquaculture	4	0.5
Total	**825**	**100.0**

Source: Rural Agricultural Water Resource Information System, https://rawris.ekr.or.kr/.

StatLink https://doi.org/10.1787/888933852369

The total budget of the Ministry of Environment (ME) increased by an average of 5.9% annually during the last 10 years. The budget for water quality control also increased by 5.2%, but it has been decreasing since 2015. The annual budget of the (ME) was KRW 5.7 trillion (USD 4.9 billion), of which KRW 3.4 trillion (USD 2.9 billion) (or 60%) was used for water and sewage related managements (ME, 2016b). MAFRA also allocates part of its budget to preventing pollution of rural water and improving agricultural water quality; the expenditure was KRW 12 billion (USD 10.6 million) in 2015. The public companies, K-Water and KRC are the distribution and implementation channels of the budgets for water quality improvement.

Like other environmental regulations, those on water quality also comprised command-and-controls and incentives (Kwon, 2013). Most of the regulations are applied to the point sources, but a regional level comprehensive pollution control system exists for diffuse pollution (OECD, 2017a).

- **Permission and Limitation of Effluent Facilities**: Either installing new waste-water emitting facilities or altering existing facilities must be permitted by the local authorities. Permission is given only if the facility's effluent does not violate the effluent standards. Installation of the facility can be limited if there is a probability of its resulting in violation of any water quality standards, or if it is to be located in a region designated as a source of drinking water.
- **Regulations on the Operation of Effluent or Preventing Facilities**: All permitted effluent facilities have to install water pollution preventing facilities to keep the effluent standards.
- **Total Maximum Daily Load Management System**: This policy sets up the water quality targets of a selected river and controls the total water pollution load in the river basin. The total load of a river basin is allocated to the local governments and facilities in the region. Instead of targeting the achievement of all 20 water quality standards, TMDL clarifies the liabilities of local governments by means of

designating only two criteria, BOD and total phosphorus discharges. Once the target load is reached, the local government is subsidised by the central government for constructing environmental infrastructure for the region. Moreover, the River Basin Fund collected from the tap water fees of downstream consumers are also provided to the participating local governments under the TMDL system.[8]

- **Environment Improvement Charge:** This is an economic incentive applied for water quality improvement. It is a price incentive and currently no cap-and-trade system is operating for water quality management in Korea. The charge is applied to facilities and automobiles emitting air or water pollutants. The charge on sewage is adjusted by the pollution intensity and location.

More recent policy interest is in the control of non-point sources, especially agricultural source runoff. ME and MAFRA are working together to introduce a joint agricultural runoff management programme (ME, 2017b). The programme may designate agricultural runoff management zones, and farmers in the zones will be subsidised if they apply best management practices under contracts with the government. Thus the system will require the cross-compliance of farmers.

Farmers cultivating land near drinking water sources will be assisted if they change their production items to those generating less soil erosion, under which polluters are paid rather than paying for diffuse pollution (OECD, 2012). In this way, they may provide a service to city through lowering treatment costs. Discussions are ongoing on the possibility of linking runoff management with the TDML system. Abatement of agricultural runoffs in a region may be deducted from the total water pollution load of the region. Regulations on livestock manure are becoming stricter, and stricter standards on manure effluent will be imposed. At the same, the government is increasing its investment for public facilities to treat and recover manure for fertiliser use: the aim is to treat 50% of total manure with these facilities by 2025.

4.4. Labour market policy

Labour market policy influences employment composition and labour mobility. It can play an important role in facilitating structural adjustment in agriculture, for example by assisting excess labour in farming to exploit more remunerative non-farm income and employment opportunities. Policies on skills improvement and on international mobility of human resources can also help to match labour supply with demand and can affect innovation and knowledge transfer through exchange of skills and skilled labour. Skills improvement policies could encourage young and better educated farmers to enter the sector and adopt more productive and sustainable practices.

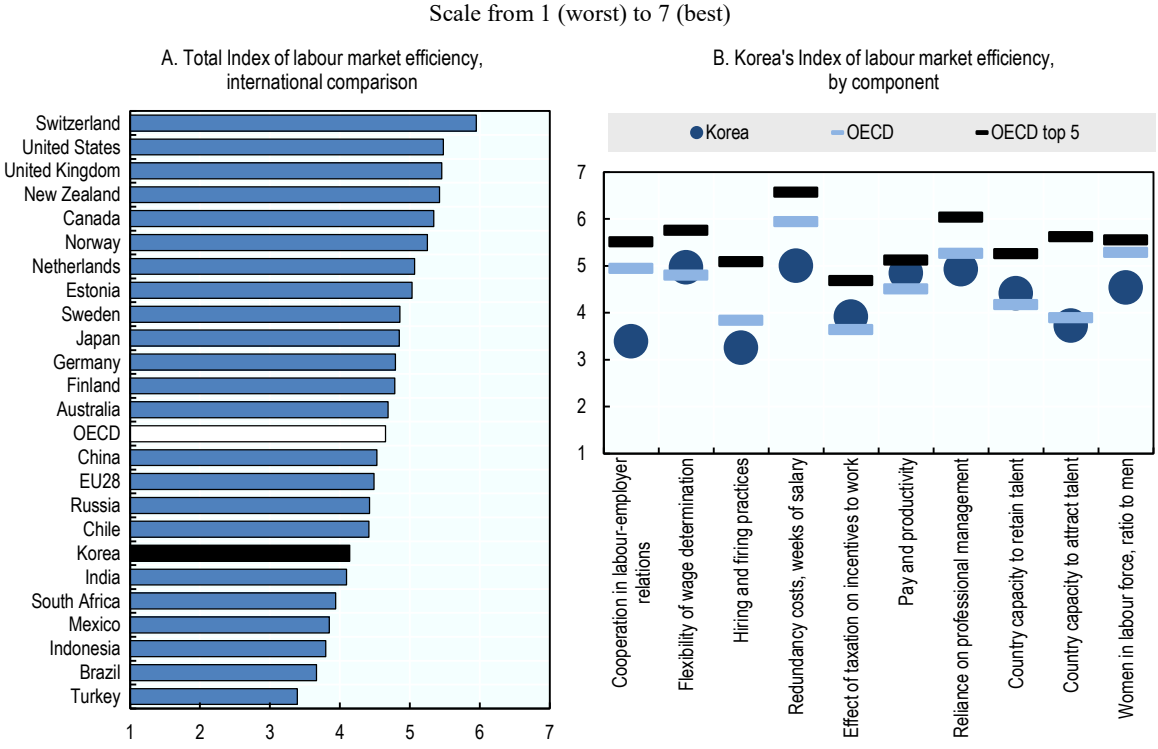
Korea's labour market policy has moved towards enhancing flexibility, but controversy continues over this policy direction. Labour market challenges include long working hours, polarisation of the labour market between regular and contract workers, deterioration of employment elasticity, and a low employment rate among women. The labour mobility rate in Korea was 62% in 2014, the second highest in OECD countries after Turkey. The proportion of temporary workers is 22%, which was higher than the OECD average of 11% in 2014.[9] The average number of years of workers' service in Korea is 5.6 years in 2014, which is the lowest among OECD countries excluding the United States, and the proportion of long-term employees over ten years is also very low.

Comparisons between contract and regular workers in Korea show big differences in working conditions such as wage, social insurance, and employment stability. The social

insurance coverage rate of contract workers is half of that of regular workers. While the average employment period of regular workers is seven years and three months, that of contract workers is two years and five months. This difference becomes larger for large enterprises. The wage of contract workers in SMEs is only 35% that of regular workers in large enterprises.

The OECD indicator of employment protection that compares the strictness of employment protection legislation among member countries shows that the severity of dismissal in Korea is less flexible than the average (OECD, 2016b).[10] The individual dismissal severity for regular workers in Korea was slightly higher than the OECD average, while the severity of collective dismissal was less restrictive than the average. On the other hand, the World Economic Forum ranked Korea's labour market efficiency 77th out of 138 countries in 2016/17. The least competitive areas were co-operation in labour-employer relations, hiring and firing practices, redundancy costs, weeks of salary and ratio of women to men in the labour force (Figure 4.5).

Figure 4.5. Global Competitiveness Index: Labour market efficiency, 2016-17



Note: Indices for EU28 and OECD are the simple average of member-country indices. OECD top 5 refers to the average of the scores for the top 5 performers among OECD countries (Switzerland, United States, United Kingdom, New Zealand and Canada).
Source: World Economic Forum (2016), *The Global Competitiveness Report 2016-2017*, https://www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1.

StatLink https://doi.org/10.1787/888933851799

Korea's declining working population (since 2017) are leading to supply and demand unbalances across the sectors. In particular, youth unemployment problems, labour shortages in agriculture, forestry and fisheries, construction and small and medium manufacturing sectors have intensified in recent years. As Korea's agricultural labour force is mostly family labour, the proportion of regular workers, temporary workers, and daily workers is very low (Table 4.4). Farmers traditionally used unpaid family labour when they had a temporary need. However, the number of household members between 15 and 65 years old per farm household decreased from 3.0 to 1.4 between 1970 and 2012. This increased the temporary need for non-family labour in labour-intensive periods (Eom et al., 2016).

Table 4.4. Employment in agriculture by status in Korea, selected years

Share (%)

	2006	2010	2014
Regular workers	0.9	1.1	1.8
Temporary workers	1.2	1.8	1.2
Daily workers	6.1	6.3	5.1
Employers	2.6	3.2	2.8
Self-employed	60.3	60.1	61.3
Unpaid family workers	28.9	27.5	27.7
Total	**100.0**	**100.0**	**100.0**

Note: Regular workers are those whose contracts last for 12 months and over; temporary workers are those whose contracts last for more than one month and less than 12 months; daily workers are those whose contracts last for less than one month or who are employed daily; employers are those who run a business with one or more paid employees; the self-employed are those who perform professional work or run a business on their own or with unpaid family members; unpaid family workers are those who work for 18 hours and over during the period of one week in a family business or in farm without pay.
Source: KOSTAT (2016b), Economically Active Population Survey.

StatLink https://doi.org/10.1787/888933852388

Previously, the main labour market policy in agriculture was to promote family succession. However, as the farming population declined and aged, the lack of agricultural workers was recognised as an important area for policy attention. In the 2000s, the government implemented policies to support agricultural labour that suits local characteristics, to promote professional agricultural companies, to introduce foreign agricultural workers, to promote agricultural mechanisation and to utilise unemployed labour in rural areas (Box 4.4). In 2004, comprehensive measures to support elite farmers were launched, and investment in agriculture manpower and agriculture education strengthened at the national level.

Korea's labour-related legislation stipulates minimum standards for working conditions such as wages and working hours. For example, the minimum wage system was applied only to manufacturing firms with 10 or more workers when it was first implemented in 1988. In 1990, however, the system was extended to cover workplaces with more than ten workers in all industries. In 1999, the system was further expanded to include workplaces with more than five workers. It was finally expanded to all workplaces in all industries from 2000. The minimum wage system is now applied to all agricultural workers.[11]

While most labour laws apply to the agricultural sector, there are some exceptions. For example, in the case of dismissal for business reasons, the employer must notify the

Ministry of Employment and Labour 30 days before the dismissal if the business is over a certain size. However, since the agricultural sector is mostly composed of small-scale businesses, it is very unlikely that this provision will be applied. Korea's labour laws also protect contract workers, ensure stable employment of fixed-term workers, and impose overtime restrictions for short-time workers. However, such laws apply to businesses or workplaces that employ more than five workers at all times. Since only some provisions of relevant laws apply to businesses or workplaces employing four or fewer employees, most agricultural workers are unlikely to be covered by all provisions. Although the Employment Insurance Act applies to all businesses and all workers, it does not apply to employers with four or fewer employees. In addition, the Industrial Accident Compensation Insurance Act does not apply to businesses that are corporations of agriculture, forestry (excluding the lumber industry), fishery and hunting, and employ less than five full-time workers. Additionally, the dispatch of agency workers is allowed only for those judged to be appropriate in view of expertise, skill, experience or nature of work, but the agricultural sector is not eligible for agency workers.

Box 4.4. Development of immigration policy related to Korea's agricultural labour force

Foreign labour accepted through the Employment Permit System (EPS) has largely filled labour shortages in horticulture (berries, vegetables, mushrooms, etc.) and stockbreeding. Although the data on the proportion of foreign labour in the total agricultural labour force is incomplete, the number of agricultural foreign labourers has been steadily increasing over the past decade, when the problem of agricultural labour shortages have become severe. According to the 2016 Foreigner Labour Force Survey, 5.3% of all foreign employees are employed in agriculture, forestry and fisheries, and 2.8% of all foreign employees are employed as "skilled" in agriculture, forestry and fisheries by occupation. The number of foreigners engaged in agriculture, forestry and fisheries has been on an increasing trend since 2013. This figure includes all types of migrants employed in Korea, including marriage migrants and ethnic Korean returnees, but most male migrant workers are estimated to be EPS workers.[1]

Since the official launch of the EPS in 2004, foreigners from 15 countries have been allowed to work in the agricultural sector in Korea.[2] A farmer who wants to hire migrant workers must submit an application for the recruitment of local workers to the job centre. The recruitment advertisement is posted for 7 days and if the posted job vacancies are left unfilled even though the job posting period is over, the farmer can then make an application to hire migrant workers. The government has also established qualification requirements for hiring migrant workers. With the adoption of a point system in 2012, farmers with the highest points are first allocated migrant workers. A maximum of 5 to 20 foreign workers can be hired per farm depending on the type of agricultural product and farm size.

The Korean government employs migration policy to induce migrant workers to work in the agricultural sector on a long-term basis. Migrant workers on E-9 visas are allowed to sign an employment contract for up to three years. If the employer expresses his willingness to rehire, migrant workers can extend their contract for up to four years and ten months. Beginning July 2012, a re-entry scheme for qualified migrant workers on E-9 visa was launched. The Korean government issues an E-7 visa to E-9 visa holders who have upgraded their job skills and proved their proficiency in the Korean language. This policy applies to migrant workers who have worked in agriculture for four years within the past ten years. Those eligible for E-7 visas need to meet other qualifications set by the government. For example, they need to earn at least the average wage of Korean workers employed in the same job or have a national technical

qualification certificate. E-7 visa holders may extend their stay as long as they have a job in Korea, and may be accompanied by family members.

With the introduction of a working visit (H-2) visa in February of 2007, ethnic Koreans from the People's Republic of China and the former Soviet Union are also officially allowed to work in agriculture. However, ethnic Korean workers on H-2 visas tend to work in the capital and its vicinities as they are allowed to choose their jobs freely. Nonetheless, the government has been promoting their employment in the agricultural sector since 2008, providing incentives for those working in agriculture. In 2008, those who have served for two years or longer in agriculture without changing their workplace are allowed to invite up to two members of their family. In December of 2009, the government implemented a policy to grant permanent residency (F-5) to H-2 visa holders who have continuously worked for one workplace in agriculture for more than four years. In April of 2010, the government issued an Overseas Korean (F-4) visa ensuring better rights to migrant workers on H-2 status who have worked for one workplace in agriculture for more than one year, or who have done so for more than six months and acquired a national technical qualification certificate in a related field (Choi et al., 2016).

In the case of the EPS, migrant workers are required to be employed throughout the year. As a result, when labour demand is temporary, farmers tend to hire undocumented migrants through their acquaintances or private recruitment agencies. The Korean government uses two methods to respond to seasonal labour shortages in horticulture. In July 2009, the government introduced a new Addition of Workplace System that allows migrant workers to enter into an employment contract with and work for another farmer for a certain period of time while maintaining a contractual relationship with the initial employer. Migrant workers on E-9 visas return to their original workplace when their new employment contract between two to four months expires. However, the utilisation of this system is not high because of its complex process. The government also implemented a seasonal worker pilot scheme from the second half of 2015 and formally announced the introduction of a seasonal worker system from 2017. The seasonal workers can be hired for up to three months, and the term is not renewable.

Notes: 1. Recognizing a growing need for labour in agriculture, the government decided in 2002 to launch the foreign training system in agriculture. The foreign trainee system had been criticised for being more of a 'labour' programme than one for transferring skills to foreign workers. In 2007, the two systems for admitting migrant workers to Korea were integrated into the EPS. The quota for EPS workers in agriculture increased from 6 000 to 7 900 between 2007 and 2013.
2. Fifteen countries include the Philippines, Thailand, Indonesia, Sri Lanka, Viet Nam, Mongolia, Uzbekistan, Cambodia, Pakistan, China, Bangladesh, Kyrgyzstan, Nepal, Myanmar and East Timor. Laos was added to the list of source countries in 2016.

4.5. Social security policy

As a result of outmigration and limited new entrance to agriculture, the proportion of the farm population over 65 years old increased from 5% in 1970 to 38% in 2015. Agricultural activity has become a form of social safety net for the older-age rural population (OECD, 2017e). Korea has been increasing policy efforts to support the voluntary retirement of aged farmers (Box 4.5). However, the general social security policy, including the pension system, has a strong implication on the structural adjustment of Korean agriculture through retirement of aged farmers.

Social pension system

The social security system of Korea is composed of three main building blocks: social insurance, public aid, and social services. Social insurance consists of social pension programmes, national health insurance, unemployment insurance, and industrial accident compensation insurance. The social pension system is currently composed of a basic old-age pension, a national pension (NP), and public occupation pensions. NP is by far the most important pension in terms of the number of insured and the total amount of contribution. It was introduced in 1988 and its compulsory application was gradually expanded from workplaces with ten or more employees to all workplaces with one employee or more, in 2006. The number of the insured increased from 4.4 million in 1988 to 21.6 million in 2015. The expansion of compulsory coverage and progressive ageing of society has increased the number of beneficiaries from 0.5 million in 1993 to 4.0 million in 2015 (NPS and NPRI, 2016).

In spite of its expansion of coverage, a number of issues concerning NP have been debated in recent years. First, NP is a defined benefit-funded scheme and not a pay-as-you-go system as in many other OECD countries. However, it is projected, even after two major reforms in 1998 and 2007, to be depleted in 2060 due to the rapid ageing of the society and the imbalance between the contribution and the income replacement rates (Kim, S., 2013). Second, the coverage of pension beneficiaries among the elderly remains low because NP has a short history and the initial coverage was limited to those who were employed by larger companies. In 2015, only 40% of the population aged 65 and older were beneficiaries of the public pension system. Third, the level of the pension benefit is too low to guarantee a reasonable living standard mainly because of the short contribution history for the most beneficiaries. In 2015, the average old-age benefit was KRW 337 560 (USD 290) which was 13% of the average monthly wage of SMEs in the manufacturing sector and 55% of the minimum living expenses of a one-person household that the government applied in National Basic Livelihood Guarantee programme (NPS and NPRI, 2016).

To cope with low pension coverage, the government established a basic old-age pension in 2008. Persons aged over 65 years old who pass a means test are entitled to receive this basic pension, with a ceiling of KRW 200 000 (USD 172) per month in 2016. The amount of the basic pension increases as the recipients contributed to NP in a shorter period. However, Won (2013) suggests that the design of the basic pension discourages participation in NP.

Farmers also have a relatively short history with the NP system, as their participation only became compulsory in 1995. Since then, the government has financially supported their contribution. In 2017, the government covered half of the statutory premium if the self-reported monthly income, including salary, wage, and business income, is less than KRW 910 000 (USD 784). Support to the pension premium is fixed at KRW 40 950 (USD 35) a month if the contributor's income exceeds the threshold. The total amount of support was estimated at KRW 176 billion (USD 151 million) in 2017 (MAFRA, 2016b).

Despite compulsory participation and financial support from the government, a number of farmers are still not participating in NP. A survey in 2011 reported that 16.9% of 112 farmers from four villages who were younger than 60 were not insured by NP (Park et al, 2011). Similarly, a large number of farmers at retirement age are not covered by NP. The same survey reported that about 61% of the sample farmers aged 60 years and older were not paid NP benefits. This reflects the fact that compulsory participation of farmers in NP started in 1995 and that the actual participation rate of the farmers has been low. Secondly, the amount of the pension is not high enough to ensure a reasonable level of income. In

2017, 534 000 farmers received pensions from NP; their average amount was KRW 248 000 (USD 213) per month, which was 68% of the average of all NP recipients.

Nevertheless, the basic old-age pension contributes significantly to the alleviation of poverty among elderly farmers. A survey in 2014 reported that 95% of 300 elderly farmers from three villages had applied for the basic old-age pension and 81% were receiving it. Most of them were receiving the maximum pension amount, reflecting the low NP coverage ratio of the farmer. Almost all of the recipients thought the basic pension was "helpful" or "very helpful" for living (Park and Choi, 2014).

Box 4.5. Policy to support retirement of aged farmers in Korea

Korea's extraordinarily rapid ageing is progressing especially quickly in the agricultural sector and rural areas. In 2015, the share of persons aged 65 years and older in the employed was 42% in agriculture, compared with 8% in the whole economy. Heads of households aged over 65 years of age made up 20% of the total households, but 54% of agricultural households. At the farm level, ageing can decrease productivity and income because of health conditions, adaptability to changing market situations, and new technologies (Lee, 2015). Furthermore, if intergenerational transfers of resources do not take place smoothly, for example due to a lack of alternative income sources such as pension for older generation farmers, the overall productivity enhancement of the sector can be hampered.

Korea introduced several policy measures to support the retirement of aged farmers. An early retirement payment was introduced in 1997 as the first direct payment programme in Korea. A farm operator aged between 65 and 75 years can receive a fixed payment per ha every month until he reaches 75 years old if the farmland is "transferred" by either selling or renting it out. The farmer is required to have continuously operated the farm for at least 10 years before the transfer. If the farmland is sold, the buyer must be a farmer who is younger than 64 years old and operates the farm on a full-time basis or who is younger than 50 years old and has continuously operated the farm for at least three years. This programme has a clear structural policy objective: to enlarge the operation size of young, active farmers by proving incentives for elderly farmers to transfer their land. By the end of 2015, about 100 000 farmers had participated in this programme, transferring 76 000 ha of farmland. It is often claimed that the payment per ha per year (KRW 3 million – USD 2 584 – in 2017) is not sufficient to encourage transfer. For example, MAFRA (2016b) indicates that it covers only half of the income from rice production per ha (KRW 5.6 million – USD 4 950 – in 2015). Price support and direct payment requires farmers to produce, in general, provide incentives for farmers to stay in farming. Rice production is easy for the elderly to perform due to an adequate supply of contract machine services. The inadequate income from other, more general sources such as NP or basic income also induce elderly farmers to retain their farmland and remain farm operators.

As a part of its farmland bank activities, KRC has also been implementing the farmland pension programme since 2011.The programme provides a monthly pension to farmers over the age of 65 who enter a contract with KRC using their individual farmland as collateral. To enter the contract, a farmer is required to have operated a farm for at least five years. The amount of the monthly payment is determined by the age of the famer and the value of the farmland. KRC is repaid on the basis of the collateral after the death of the farmer. The remainder of the value of the land is inherited by the farmer's legal heirs after deducting the amount of the pension paid. If the remaining value is negative, the heirs bear no liability. By the end of 2016, about 6 783 farmers had entered contracts. The average size of the farmland under the contracts was about 4 000 m2 and the average monthly pension was about KRW 1 million (USD 860). Unlike the early retirement payment, the farmer is not required to rent out their land to receive the pension. There is a concern that the farmland transfer direct payment programme and the

farmland pension might not be well-aligned because the former encourages the transfer of farmland while the latter allow farmers to continuing farming without selling or renting their land.

National health insurance

National Health Insurance (NHI) was introduced in 1977. Initially covering those employed in workplaces with 500 or more employees, the scheme expanded to cover smaller workplaces in 1981, farmers and fishermen in 1988, and the self-employed in 1989. The coverage of NHI increased to 97% of the population in 2015 (NHIS, 2016). The government supports up to half of the NHI premium for farmers, among whom coverage has increased to around 90% (Park et al., 2011).

Public aid system

Unlike social insurance systems based on the contribution of the insured, the public aid system guarantees the social minimum level of living mainly though cash transfers. The National Basic Livelihood Guarantee programme (NBLG) is the most important safety net programme. It defines the threshold income by taking various factors into account and pays welfare benefits to households or persons whose income is below the threshold. Seven categories of benefits exist to cover basic needs, including housing, education and medical services. In 2015, 1.10 million households (1.65 million persons) benefited from this programme.

However, NBLG covers only a very small number of farmers. In 2015, the programme covered only 3 758 farmers, or 3.4% of those covered by the programme who were economically active; this was lower than the share of employment in agriculture of 5.2%. Considering that the incidence of poverty among rural households is more than two times higher than among urban households, the coverage of farm households is very low. This suggests that the income generation rate of their assets (mainly farmland) is set too high, although special treatment is applied in the calculation of their earned income.[12]

4.6. Education and skills policy

Overall education status

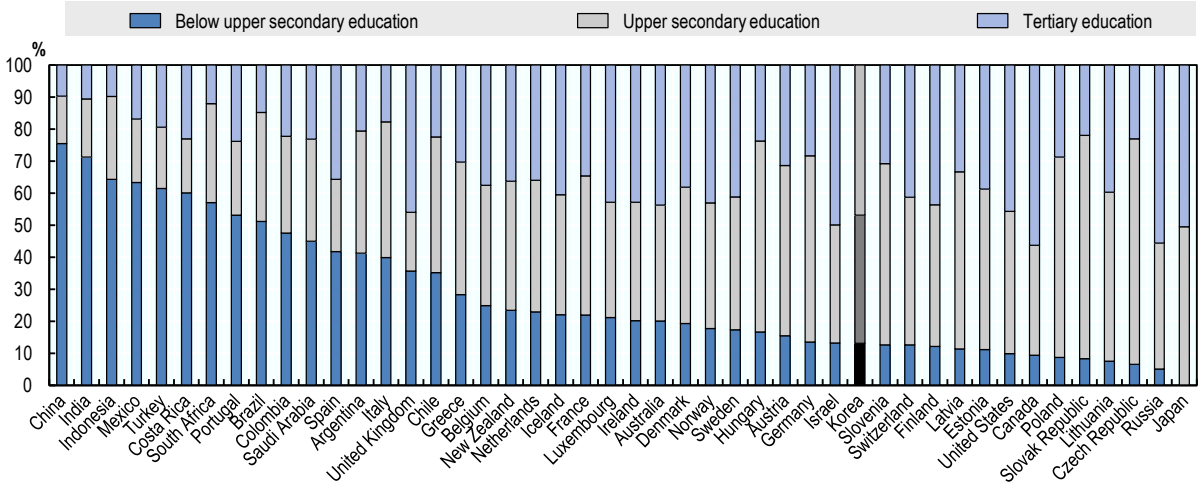
Korea has a 6-3-3-4 educational system, which consists of pre-primary education, primary education, secondary education, and higher education. One of the highest intensities of public and private education expenditure (6.7% of GDP) among the OECD countries supported the achievement of its high enrolment and advancement rate. The enrolment rate has steadily increased to over 90% for elementary, middle, and high schools, and 69% for higher education in 2016 (Figure 4.6). Generally, the advancement rate in Korea is very high. For example, in 2010 the advancement rate in vocational high school was 71%.

The Korean education system is often criticised for its overemphasis on tertiary education over vocational education (Jones, 2013). In contrast to most other OECD countries, the share of inactive youth is higher for tertiary graduates in Korea than for those with high-school education. The employment rate of university graduates is lower than average employment rate among OECD nations (OECD, 2014). The mismatch rate between undergraduate major and the first job among university graduates is reported as 37% (Lee, 2016). While university graduates are mismatched to their jobs, SMEs face labour shortages, including in agriculture. One main potential reason for the high mismatch rate is

consistently voiced by employers: that the curricula of the formal educational institutes are not deeply related to the skills required at the workplaces. It is necessary to gradually shift the focus of the Korean education system from chasing the degree and prestige of high-ranking universities to rewarding the acquisition of skills that are demanded in the labour market (Jones, 2013).

Figure 4.6. Educational attainment, 2016

Percentage of the population aged 25-64 years old



Note: Upper secondary education includes post-secondary non-tertiary education. In most countries, data refer to ISCED 2011. For Indonesia, Saudi Arabia and South Africa data refer to ISCED-97. Data for Brazil, Chile, Indonesia, Ireland, Russia and South Africa refer to year 2015, for Argentina and Saudi Arabia to 2014; for India to 2011 and for China to 2010.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Source: OECD (2017), *Education at a Glance 2017: OECD Indicators*, http://dx.doi.org/10.1787/edu-data-en.

StatLink https://doi.org/10.1787/888933851818

Recently, the concept of a competency-based society has gained prominence and the government guides the graduates from vocational high school to put jobs at first. Since 1999, the Korean government has developed national standards regarding abilities required in real workplaces. From 2002, the Ministry of Education started to develop the Korea Skills Standards and the Ministry of Employment and Labor started to develop the National Occupational Standards. In 2010, those efforts to establish a skills standard were unified to the National Competency Standards (NCS) as the nationally developed systemic contents of knowledge, skills, and attitude required for workers to perform jobs in real workplaces. By December 2014, 797 NCSs had been developed.

The development of the educational environment is an important element to enhance the quality of life in rural areas. It includes the acquisition of excellent teachers, the improvement of career education, the extension of pre-school programmes, and the improvement of foreign language, physical and art education (Jeong et al., 2014). Overall, the educational environment of rural areas has fallen behind that of urban areas. In response, the Ministry of Education is implementing two major projects to improve the quality of life for farmers and fishers. The project supports a hub of excellence for middle

schools in rural areas to promote the influx of students from urban areas. Since 2013, the Ministry of Education selected 80 middle schools and provided approximately USD 1 million for each school for three years. The financial support allowed the selected middle schools to improve educational facilities and delivered various educational programmes (such as the School Creative Career Education Program, sports clubs, orchestra, foreign language programmes). The second project involves ICT facility construction and the distribution of educational content at primary, middle and high schools.

Vocational education in agriculture

According to the Statistical Yearbook of Education (Ministry of Education, 2016), there are 472 vocational education specialised high schools with 287 772 students. Approximately 6% of them study at 37 agricultural high schools. Some agricultural high schools are specialised in specific areas such as horticulture, horseracing, cooking and herbal medicine. Approximately 40% of the graduates of agricultural high schools are employed after graduation, of which half obtain agriculture-related jobs and another 40% proceed to higher educational institutes. The share of graduates who become self-employed farmers is about 1%. At the tertiary level of education, Korea has 37 agricultural colleges in four-year universities and five agriculture-specialised two- and three-year colleges. According to Yang et al. (2015) approximately 30 000 students are enrolled in agricultural colleges and universities. The overall employment rate was 59%; of those students, 62% get a job in agriculture and the rate of becoming a self-managed farmer is about 7%.

The government also established the Korea National College of Agriculture and Fisheries in 1997 as a professional school to foster future leaders in agriculture. The tuition and admission fees are exempted for three-year programmes and the government also supports other expenses. Graduates are eligible for a subsidy for young farmers, but required to engage in farming for at least six years.

The Korea Agency of Education, Promotion and Information Service in Food, Agriculture, Forestry and Fisheries (EPIS) is responsible for delivering education and MAFRA training policies. One of its major projects is financial support for agricultural high schools and agricultural colleges. In 2015, EPIS supported 19 high schools and 14 colleges in delivering a practical curriculum to support students in advancing to an agriculture-related career. In 2016, MAFRA selected three agricultural high-schools and provided approximately USD 2 million for each to raise practical competencies required in the agricultural field. In those high-schools more than 70% of the curriculum should be vocational subjects and more than 70% of vocational subjects should consist of experimental subjects.

4.7. Summary

Korea has developed a competitive transportation and ICT infrastructure, including in rural areas. The government promotes the Smart Agriculture project to make use of ICT to improve the competitiveness of Korean agriculture, but the application of ICT to agriculture tends to be supply-driven. Collaboration between producers, retailers, R&D institutions and ICT industries is key to developing ICT to meet the demands of stakeholders and induce the adoption of technology at the farm level.

A widening income gap between urban and rural areas arising from rapid industrialisation has been a major policy issue in Korea. Together with structural change in the agricultural sector, diversification of income sources to off-farm employment is the main pathway to

address low income issues in rural areas. Despite government efforts to develop rural infrastructure and provide incentives to attract non-farm business activity to rural areas, young and skilled workers tend to leave those areas and the ageing of the rural population has advanced much quicker than in urban areas. Korea can exploit the opportunities in rural area for more space intensive activities, more flexibility in land use, less congestion, lower housing costs and less environmental pressure (OECD, 2016c). A comprehensive rural development policy beyond primary agriculture should play a major role in redressing this issue. OECD (2016d, 2018) finds that taking a more bottom-up approach and promoting integrated investments and public services that are geared to local needs contributes to increasing rural competitiveness and productivity.

The food manufacturing industry has the potential to create more employment in rural area, add more value to primary agricultural production and open more possibilities to explore export markets. The government should enhance vertical co-ordination between producers and downstream industries by removing the restrictions on investment in agriculture, particularly in terms of ownership of farmland and investment in agricultural corporation. Promoting partnerships between producers and participants in the food supply chain (retailers, manufactures and others) allows farmers to respond to market demand and to introduce new technology or business models.

Korea's low-income issue concentrates on small-scale aged farm households. The short history of Korea's compulsory national pension system has led to a low level of social protection for farmers. Under the current production-based support system, older farmers tend to continue farming to secure their livelihood. Korea could develop a more coherent policy framework to address this low-income issue and encourage the voluntary retirement of aged farmers through enhancing the role of general social security system and possibly increasing the linkage to agricultural policy objectives. For example, Korea's National Basic Livelihood Guarantee is a general social welfare programme, but only a very small number of farmers are covered by it due to their ownership of agricultural production assets such as farmland, and the difficulty of assessing their income in the absence of an income declaration requirement for farmers.

Fragmentation of farmland is a major constraint to improving the productivity of land-intensive agriculture in Korea. The main drivers accelerating this fragmentation are subdivision of farmland ownership through inheritance and land conversion to non-agricultural use. The land tax system could be improved by encouraging inheritance to a single successor as well as imposing a higher property tax if farmers do not use farmland. In Korea, strong protection of farm ownership based on the owner farming principle restricts farmland leasing except for a few exceptional cases. This discourages land owners from leasing farmland based on a formal land lease contract. Informal land lease contracts are often unstable and short-term, and they discourage long-term stable farm management and investment. The farmland regulations should be revised to promote tenant farming and penalise undocumented land rental transactions, which would also contribute to the targeting of the direct payment programme to the actual cultivator.

Farmers usually receive their irrigation water either from KRC or from the local government. In regions where KRC provides irrigation water, there is currently no irrigation price and the water is free; in other regions, the price of water does not recover operation and maintenance charges. This system encourages farmer to continue using water despite increased water stress – already very high relative to other OECD countries – and demand from other sectors. It also reduces the incentive to adopt water saving technologies, which could increase the risk to sustainable use of water in the face of climate change.

A well-functioning labour market gives the agri-food sector the flexibility to adjust quickly to change in labour and skill needs. Given the current demographic trend, Korea will increasingly face greater labour shortage problems, particularly in agricultural sector. The capacity of agriculture to attract skilled labours from both domestic and foreign labour markets is crucial for sustainable productivity growth in the sector. Promoting the corporate organisation of agricultural operations facilitate the entry of young generations based on a formal employment contracts. The labour market should also be able to meet the need for temporary agricultural labour. One possible area of reform is to allow human resource companies to dispatch agency workers to agriculture.

The intensity of public and private expenditure on education in Korea is one of the highest among OECD countries. The government is also increasing investment in improving the quality of education in rural areas. Enrolment rates to higher education reached 69%, and the education system in Korea is largely degree-oriented. Strengthening professional education to provide the skills required in agriculture is an important policy agenda to foster human capital in the sector.

Notes

[1] "Social Overhead Capital" is the capital that is available for everyone and used for the overall production of society, which includes various public facilities such as ports, roads, railways, electricity, and gas (MOSF, 2016).

[2] The term of the 6th industry is based on the three-sector theory which divides economies into three sectors of activity: extraction of raw materials (primary), manufacturing (secondary), and services (tertiary). Naming a certain business as the 6th industry indicates that it connects primary industries with the secondary sector such as processing of agricultural products and the development of specialities and the tertiary sector such as marketing and tourism business.

[3] Certified business operators can use the certification mark on the business site, the product, and the promotional material. And they are given points when selecting the applicants for support projects for funding, consulting, finding a market and promotion. In addition, the government is providing management consulting and financial support. In 2016, 38% of certified business operators were non-agricultural businessmen, 33% agricultural corporations, and 19% individual farmers.

[4] KRC is a public enterprise that contributes to increasing agricultural productivity through water resources development and management in addition to farmland development and management. KRC uses the Farmland Management Fund established by government to conduct projects related to the scale of farming and the collectivisation, creation and efficient management of farmland.

[5] Chae, Gwang-seok et al. (2016) find that the agricultural revenue generated by farmland purchase is lower than the case of leasing farmland.

[6] In Korea, the expression water use right is preferred to water right. It refers to the right to withdraw water from natural water sources such as large and small rivers and aquifers.

[7] There are 2 703 monitoring sites of groundwater quality, and the quality is inspected twice a year. In 2014, 8% of the sites could not satisfy the standards. The use and development of groundwater are prohibited unless the standards are satisfied (ME, 2016a).

[8] TMDL is applied to the watersheds of four major rivers, and the system controls the quantity of pollutants discharged into these rivers within the scope of load allocation by means of setting a water quality target achievable at each end site of watersheds. Introduction of the system substantially reduced the pollutant load in the four major rivers in 2010 compared to that in 2004 (Park and Park, 2017).

[9] As of 2016, 66%, of the total wage workers are regular workers, 26% are temporary workers and 8% are daily workers. Non-regular workers take up 33% of all wage workers and their monthly earnings are only 54% of those of regular workers (Korea Statistical Office, 2016)

[10] The indicator covers three main areas: (1) protection against individual dismissals of regular workers, (2) regulations involving temporary employment, and (3) additional and specific requirements for collective dismissal.

[11] Korea's minimum wage is determined annually by the Minimum Wage Committee composed of labour and management and applies equally to all workplaces, regardless of region or industry.

[12] This includes exclusion of direct payment for small farmers, day-care expenses, and interest costs for agricultural production. (Article 7 of MOHW Implementation Regulation for the Special Act for the Improvement of Welfare of Rural Residents).

References

Chae, Gwangseok et al. (2016), "The management of Leases for Efficient Use of Farmland," Korea Rural Economic Institute (KERI).

Choi, Seori, Chang Won Lee and Mihwa Park (2016). "Korea's Policy of Chinese of Korean Ancestry in the Making: Negotiating ethnic priority and the protection of citizen's right", Multiculture & Peace 10(3): 106-126.

Eom, Jinyoung, Kwangseon Kim and Jieun Lim (2016), "Changes in Rural Labour Market and Policy Tasks", Research Report R774, Korea Rural Economic Institute.

Hodge, I. and M. Whitby (1981), *Rural Employment: trends, options, choices*, Methuen, London.

Hong, J.H., H.J. Moon, Y. Lee and O. S. Kwon (2006), "Competition and Regulation in Water Industry", *Korea Association of Environmental Economics*.

Jeong, J. et al. (2014), "In-depth evaluation: Fundamental plan of improving the quality of life for farmers and fishers", Korea Rural Economics Institute.

Jones, R. (2013), "Education Reform in Korea", *OECD Economics Department Working Papers*, No. 1067, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k43nxs1t9vh-en.

Kim, J.S. (2016), "Legal and Policy Issues in Effective Dam Management", National Assembly Research Service.

Kim, K.M. (2013), "Tap Water Prices and Pricing Criteria: Problems and Solutions", National Assembly Research Service.

Kim, S.S. (2013) "Pension Reform Options in Korea", paper presented at an IMF international conference in Tokyo, Japan in January 2013.

Kim, H.S., S.D. Park, K.S. Chae and H.Y. Kim (2014), "A Study on the Cost Sharing of Agricultural Water Facilities", Korea Rural Economic Institute.

KOSTAT (2016a), *Survey of Agriculture, Forestry and Fisheries*.

KOSTAT (2016b), *Economically Active Population Survey*, http://kostat.go.kr/portal/eng/pressReleases/5/2/index.board.

KREI (2018), *2017 Public Opinion Survey on Agriculture and Rural Areas*, Naju, Korea

KREI (2016), Monitoring and assessment on the implementation of rural area service standard, Korea Rural Economic Institute, Naju-shi.

Kwon, O.S. (2013), *Environmental Economics*, Pakyoungsa.

Kwon, O.S. (2009), "Determinants of Municipal Water Prices and Costs", *Environmental and Resource Economics Review* 18(4): 695-713.

Lee, Myungheon (2015), "A Study on the Long-term Trend in the Income of Korean Agricultural Households" in Jeong Hyeok eds. "Understanding Korean Economic Development from the Perspectives of Agricultural Development and Structural Transformation", *Research Report 2015-02*, Korea Development Institute.

Lee, K.Y. (2016), "Desirable Water Management from a Local Government Perspective", *Journal of Water Policy and Economy*, 26: 5-17.

Lee, J. (2016), "Mismatch between undergraduate majors and the first jobs among university graduates and labor market outcome", Korea Employment Information Service.

MAFRA (2016a), "Key Statistics in Agriculture, Forestry, Livestock holding, and Food", Ministry of Agriculture, Food and Rural Affairs, Korea.

MAFRA (2016b) "Plan for the Management of Budget and Funds 2017", Ministry of Agriculture, Food and Rural Affairs, Korea.

Ministry of Education (2016), Statistical yearbook of education.

ME (2017a), *Environmental Statistics Yearbook 2016*.

ME (2017b), "Second Water Environment Management Basic Plan (2016-2025)".

ME (2016a), "2016 White Paper of Environment".

ME (2016b), "Water Supply Statistics".

MOLIT (2013), "Water Vision 2020".

MOSF (2016), "National Fiscal Operation Plan 2016-2020."

National Health Insurance Service (2016), "Key Statistics of National Health Insurance Statistics 2015".

National Pension Service and National Pension Research Institute (2016) "National Pension Statistics Facts Book 2015".

OECD (2018), *Rural 3.0. A Framework for Rural Development*, Policy Note, Paris, http://www.oecd.org/cfe/regional-policy/Rural-3.0-Policy-Note.pdf.

OECD (2017a), "Emerging policy instruments for the control of diffuse source water pollution", in *Diffuse Pollution, Degraded Waters: Emerging Policy Solutions*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264269064-7-en.

OECD (2017b), *Enhancing Water Use Efficiency in Korea: Policy Issues and Recommendations*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264281707-en.

OECD (2017c), *Water risk hotspots for agriculture*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264279551-en.

OECD (2017d), *OECD Environmental Performance Reviews: Korea 2017*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264268265-en.

OECD (2017e), "Case study in livestock disease management: Korea", in *Producer Incentives in Livestock Disease Management*, OECD Publishing, Paris, https://doi.org/10.1787/9789264279483-10-en.

OECD (2016a), "Agriculture and water", Background note prepared for the 2016 OECD Agricultural Ministerial Meeting, OECD, Paris, http://www.oecd.org/tad/sustainable-agriculture/5_background_note.pdf.

OECD (2016b), *Employment Protection Database*, 2016.

OECD (2016c), *OECD Territorial Reviews: Japan 2016,* OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264250543-en.

OECD (2016d), *OECD Regional Outlook 2016: Productive Regions for Inclusive Societies*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264260245-en.

OECD (2014), *OECD Economic Surveys: Korea 2014*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eco_surveys-kor-2014-en.

OECD (2012), *Water Quality and Agriculture: Meeting the Policy Challenge*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264168060-en.

OECD (2010a), *Pricing Water Resources and Water and Sanitation Services*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264083608-en.

OECD (2010b), *Sustainable Management of Water Resources in Agriculture*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264083578-en.

Park, S.-C. and J. Park (2017), "Total Maximum Daily Load (TMDL) Management System in Korea," summarised in OECD (2017), "Emerging policy instruments for the control of diffuse source water pollution", *Diffuse Pollution, Degraded Waters: Emerging Policy Solutions*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264269064-7-en.

Park, D, K. Choi, K. Kim, and S. Ryu (2011), "A Study on the Health Insurance and National Pension Benefit of Farmers and Fishermen and Policy Improvement Measures", Korea Rural Economic Institute.

Park, D. and Y-u Choi (2014), "A Study on the Basic Pension Situation of Elderly Farmers", Korea Rural Economic Institute.

Won, S. (2013), "Debates on the Introduction of Basic Pension and Tasks Ahead", National Assembly Budget Office.

World Bank (2017), *World Development Indicators* (database), http://data.worldbank.org/indicator.

World Economic Forum (2016), "The Global Competitiveness Report 2016-2017: Full data Edition", Geneva 2016, www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1.

Yang, H. et al. (2015), "The status of enrolled students and career path of graduates in agricultural colleges and universities", Association of Deans of Agricultural Colleges and Universities.

Chapter 5. Agricultural policy in Korea

This chapter provides an overview of developments in agricultural policies in Korea. It also reports on trends in the level and compositions of support and discusses the likely impacts of agricultural policy measures on structural change, environmental performance and innovation in the sector.

5.1. Agricultural policy objectives

The focus of agricultural policy in Korea has evolved over the past sixty years. From the 1950s to the 1970s, efforts were concentrated primarily on increasing productivity of crops as well as achieving self-sufficiency in rice. Since the 1980s, the issue of income disparity between farm and urban households has emerged following the rapid economic growth through industrialisation. In the late 1980s and through the 1990s, the focus shifted to structural adjustment and competitiveness to cope with the opening of agricultural markets. In the most recent decade, the emphasis has shifted to a broader set of objectives including vitalizing the rural economy, exploring the export market, enhancing the environmental performance of agriculture and promoting the food industry.

From the mid-1980s, the Korean government has developed policy plans to improve the competitiveness of agriculture in response to increasing agricultural imports, termination of the exemption from the GATT Balance of Payments provision and the Uruguay Round Agreement on Agriculture. The Agricultural and Rural Basic Law of 2000 established a legal framework for Korean agriculture and rural policies, mandating the government to prepare a development plan for agriculture and rural areas. In 2007, the Basic Law was replaced by the Framework Act on Agriculture, Rural Community and Food Industry. The Framework Act introduces basic policy directions namely: 1) Stable supply of agricultural products; 2) Restructuring and sustainable development of agriculture; 3) Promotion of public functions of agriculture and rural communities; 4) Development of local agriculture and promotion of welfare of residents in rural communities.

To formulate and implement the policy, the Act mandates MAFRA to draw up an Agriculture and Rural Community and Food Industry Development Plan every five years. The previous plan (2013-17) emphasised adding value to agricultural products in an innovative way and improving agricultural productivity by integrating agriculture with other industries such as manufacturing, processing, or ICT. The Act requires the Plan to set self-sufficiency targets in food and staples, and action plans for their achievement. The targets cover calorie-based self-sufficiency and volume-based self-sufficiency in rice and barley, grains, livestock products and forage. The target of the volume-based self-sufficiency ratio of grains (including animal feed) was set as 30% in 2017, from 23% in 2013; this was to be achieved by measures such as expanding the agriculture production infrastructure and encouraging economies of scale for rice production and distribution (WTO, 2016).

The most recent policy plan for 2018-22 set four main policy targets: strengthening the income safety net; innovation for sustainable agriculture; enhancing food safety in the supply chain; and improving rural welfare. Strengthening competitiveness and growth of agriculture by enhancing agricultural productivity has been a core goal of agricultural policies in Korea. The most recent five-year policy plans diversifies the objective of agricultural policies to address more varieties of societal demands towards agriculture and rural areas (Box 5.1). The new policy plan shifted the orientation of agricultural policies further to ensure income stability and quality of life of farmers as well as the balanced development between agricultural production and environmental conservation. It also foresees a strengthening of bottom-up participation in policy.

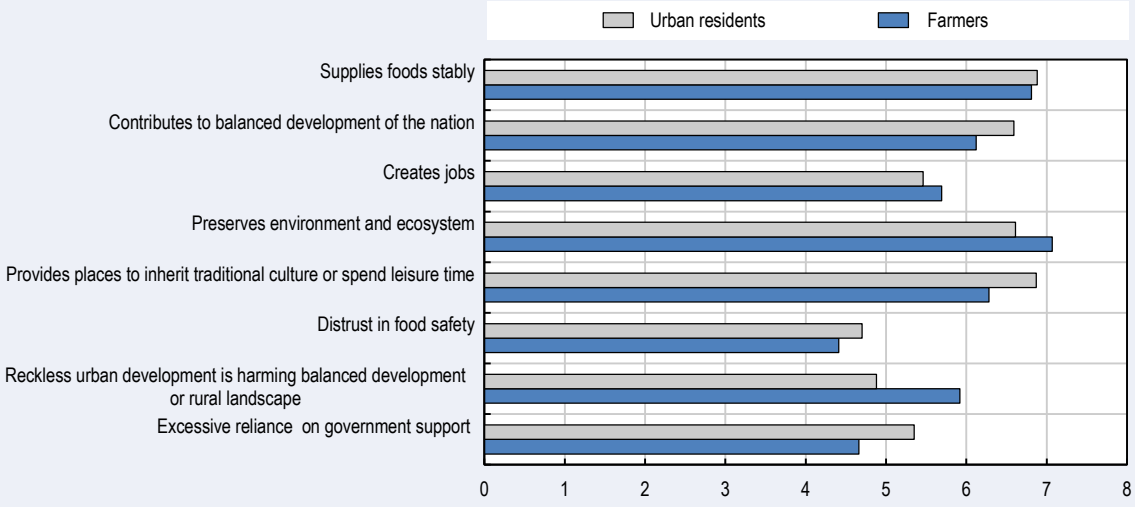
268. To achieve these policy objectives, Korea plans to strengthen agricultural innovation capacity to produce environmentally friendly and safe foods. Key policies include introducing environmental cross-compliance conditions to direct payments and a new agricultural environment preservation programme. The government also aims to

improve the environmental performance of livestock production by supporting the modernisation of cattle sheds. In addition, the government aims to revitalise the rural economy by promoting returning of people to rural areas and engaging in agriculture.

Box 5.1. Public perception on the role of agriculture and rural areas in Korea

Since 2006, KREI has been conducting an annual survey on the perceptions of urban residents and farmers towards agriculture, rural areas, and agricultural policies in Korea. The 2017 survey was conducted on samples of 936 farmers and 1 500 urban residents. The survey results show that both farmers and urban residents have a high recognition of the role of agriculture and rural areas as a stable supplier of foods, contributor to balanced development of the nation, creator of jobs and providers of places to inherit traditional culture and recreational time. Both farmers and urban residents perceive agriculture as preserving the environment and the ecosystem, but farmers have higher recognition on this point. The negative perception of urban development to harm balanced development or rural landscape was also found to be higher among farmers. On the other hand, more urban residents perceive that agriculture relied on excessive government support of rural areas than farmers. The distrust in food safety is also more common among urban residents than farmers (Figure 5.1).

Figure 5.1. Survey results on the role of agriculture and rural areas in Korea, 2017



Note: Higher score indicates a higher rate of agreement on the item.
Source: KREI (2018).

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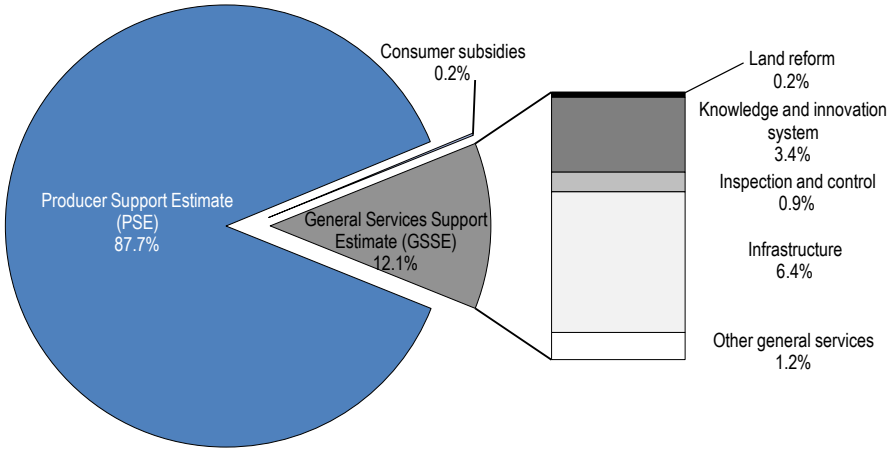
The survey also asked urban residents if they are willing to pay additional taxes to maintain the functions related to the public functions of agriculture and rural areas. The result shows that 53.8% of urban residents were willing to pay an extra tax, while 41.4% of them did not agree with additional taxes for this purpose.

5.2. Overview of domestic agricultural policy portfolio

The OECD's Producer and Consumer Support Estimates (PSE; CSE) database show that the overall portfolio of support to agriculture is largely dominated by direct support to producers. The share of support for general services (GSSE) in total support to agriculture increased from 8% in 1986-88 to 12% in 2014-16. In particular, the share of GSSE directed to long-term productivity growth such as support to knowledge and innovation, and to infrastructure increased from 53% in 1986-88 to 82% in 2014-16, reflecting the policy emphasis on competitiveness and sustainability of the agricultural sector. However, this type of support constitutes less than 10% of overall support to agriculture (Figure 5.2).

Figure 5.2. Composition of support to agriculture in Korea, 2014-16



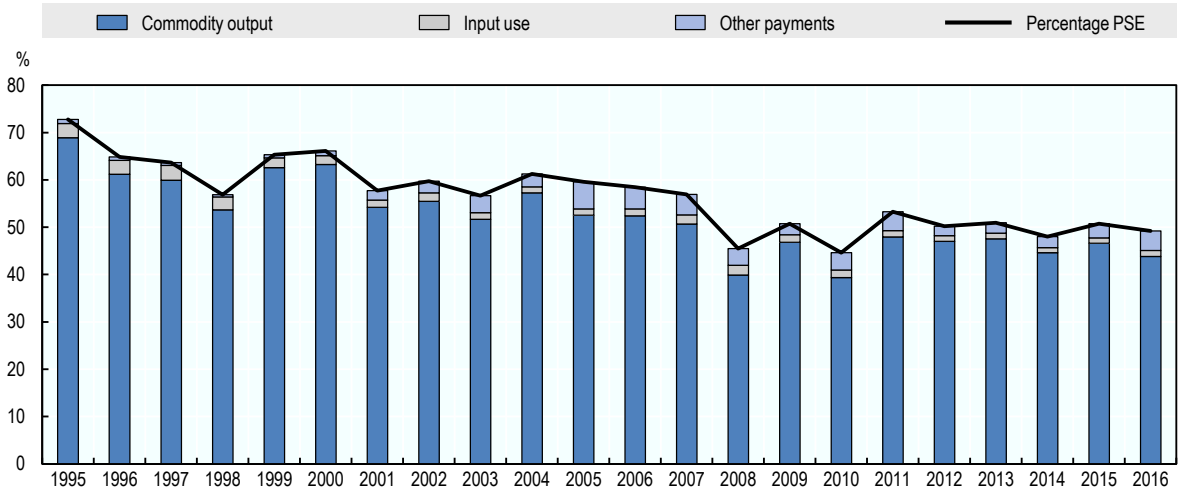
Source: OECD (2017a), "Producer and Consumer Support Estimates", OECD Agriculture statistics (database) http://dx.doi.org/10.1787/agr-pcse-data-en.

StatLink https://doi.org/10.1787/888933851856

Korea has gradually reduced its support to agriculture relative to its gross farm receipts and modest progress has been made towards more market-oriented policies. The level of PSE has gradually declined from 70% to 49% of gross farm revenue between 1986-88 and 2014-16 (Figure 5.3). However, the level of PSE is still 2.5 times higher than the OECD average, making Korea one of the countries with the highest level of support to producers. Among transfers to individual producers, the government introduced a range of direct payment programmes since the late 1990s, but market price support (MPS) continues to be the dominant element. Even though the ratio of producer prices to border prices (the Nominal Protection Coefficient) has declined from 3.3 in 1986-88 to 1.9 in 2014-16, the share of the MPS in the PSE shows only a moderate decrease – from 99% to 92% for the same period. Taking into consideration the commodity-specific budgetary transfer, 93% of producer support was dominated by transfers to specific commodity production in 2014-16 (Figure 5.4). This contrasts with a general reform direction in the OECD away from single commodity production support. Such support constrains farmers' responses to market signals and hinders structural adjustment of the sector.

Figure 5.3. Evolution of support for Korea's agricultural producers, 1995 to 2016

As a percentage of gross farm receipts



Source: OECD (2017a), "Producer and Consumer Support Estimates", *OECD Agriculture statistics* (database), http://dx.doi.org/10.1787/agr-pcse-data-en.

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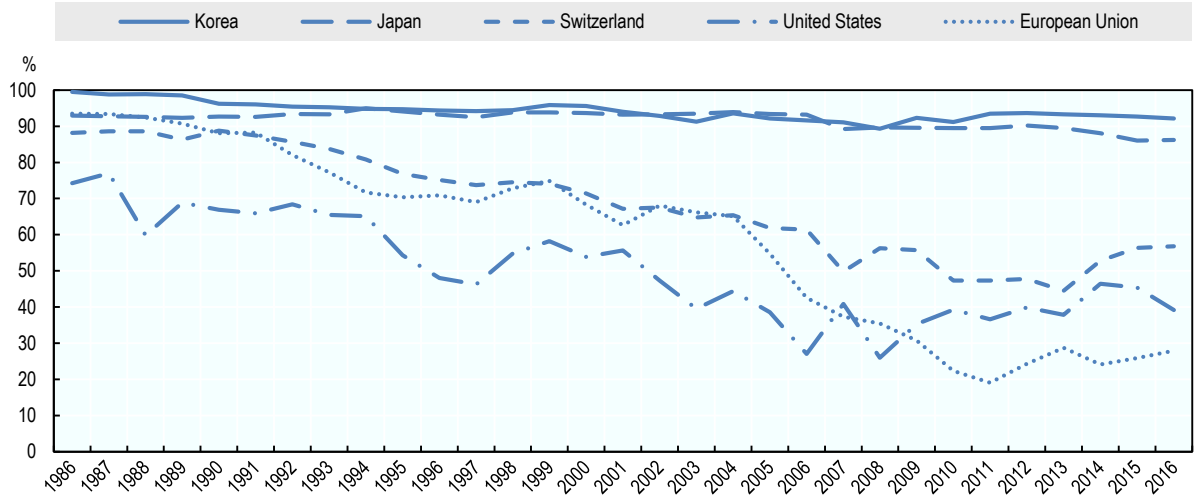
Figure 5.4. Share of single commodity transfer, 1986 to 2016

As a percentage of Producer Support Estimate

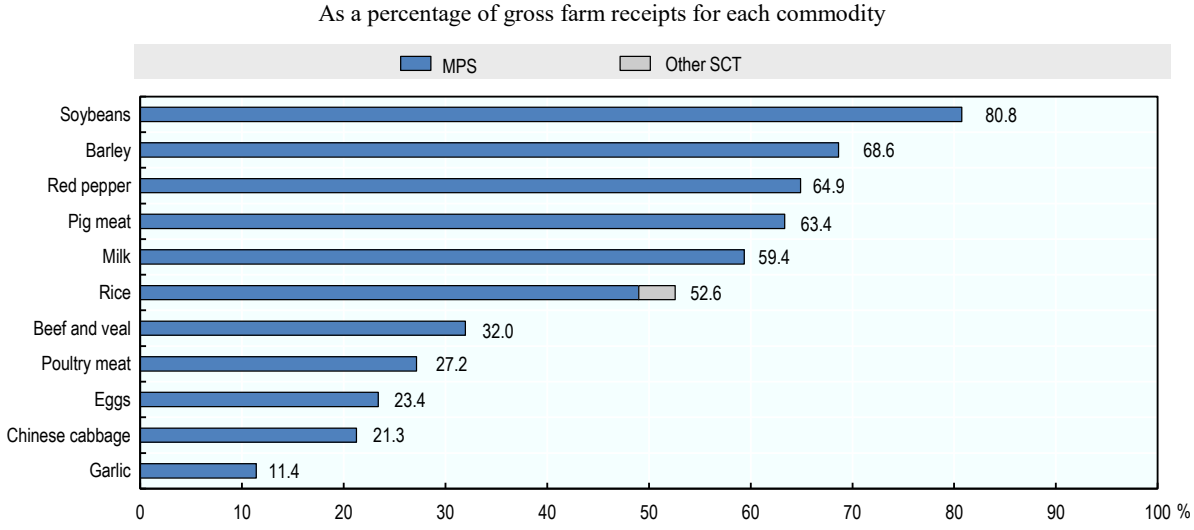


Note: European Union refers to EU12 for 1986-94, EU15 for 1995-2003, EU25 for 2004-06, EU27 for 2007-13, EU28 from 2014 onwards.
Source: OECD (2017a), "Producer and Consumer Support Estimates", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-pcse-data-en.

StatLink https://doi.org/10.1787/888933851894

In Korea, support to single commodity production is concentrated to certain upland crops (soybean and barley), rice, pig meat and milk (Figure 5.5). MPS accounts for all single commodity transfers except for rice, which receives an area-based counter-cyclical payment.

Figure 5.5. Support to specific commodities in Korea: Single Commodity Transfer, 2014-16



Source: OECD (2017a), "Producer and Consumer Support Estimates", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-pcse-data-en.

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Korea's grain procurement policy had made expenditure for public stockholding the largest component of GSSE. However, as the public procurement policy scaled down, the share of public stockholding in GSSE declined from 44% in 1986-88 to 8.5% in 2014-16. In parallel, the share of investment in Korea's agricultural knowledge and innovation system has increased from 7% in 1986-88 to 28% in 2014-16, reflecting increasing policy emphasis on the enhancement of productivity in agriculture. For example, the fiscal expenditure for R&D in three public institutions (MAFRA, RDA and KFS) increased at 7.7% annually in 2008-14 (KREI, 2015).

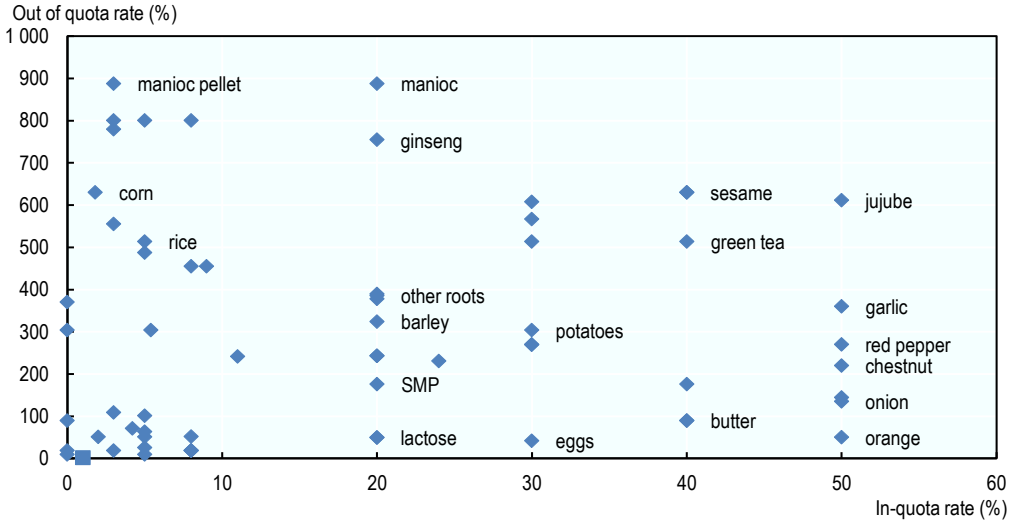
The development and maintenance of hydrological infrastructure has been by far the largest component of GSSE in the OECD's PSE/CSE database, accounting for 48% of Korea's GSSE in 2014-16. This reflects Korea's agricultural structure, which is dominated by paddy farming. By 2013, 80.6% of total rice paddy area was already equipped with irrigation facilities (KRC, 2014). The focus of irrigation investment should shift to the maintenance of existing infrastructure, increasing other types of investments to diversify agricultural production and to enhance the long-term growth potential of the sector.

5.3. Agricultural trade policy

Tariff continues to be the main instrument of protecting domestic producers. Korea maintains a total of 63 tariff rate quotas (TRQ), including for rice, barley, red pepper and garlic. In-quota rates range from 0% to 50% while out of quota rates fall between 9% and 887% (Figure 5.6). With the conclusion of the GATT Uruguay Round, trade restrictions on all agricultural products were converted to tariffs except for rice. Because rice is its most

sensitive agricultural product, Korea suspended rice tariffication from 1995 to 2014 and established a minimum market access (MMA) quota at a 5% tariff rate, in accordance with a special treatment provision in the WTO Agreement on Agriculture. The minimum market access volume increased from 51 307 tonnes in 1995 to 408 700 tonnes in 2014. As non-tariff measures on rice were transformed into a tariff system from 2015, all import restrictions on agricultural products are currently in the form of tariffs and tariff rate quotas.

Figure 5.6. Tariffs for 63 tariff rate quota products in Korea



Source: MAFRA (2014a).

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Rice is imported exclusively by state trading enterprises.[1] TRQ of table rice is managed by the Korea Agro-Fisheries and Food Trade Corporation (AT), while TRQ for rice for processing purposes is imported by MAFRA. Imports of ginseng and chestnut are administered by auction. The license-on-demand method, for either historical importers or applied on a first-come, first-served basis, governs imports of 48 products. Imports of the remaining 12 products are implemented by a mix of two or at most three quota administration methods. The AT sells table rice through auctions whereas processing rice is sold at a set price (GAIN-KS1613, 2016). MAFRA exclusively controls the country's rice imports (WTO, 2016).

The government plans to simplify the existing administrative methods to reduce the involvement of STEs or to ensure greater use of the auctioning and applied rates method. In addition, the country manages voluntary TRQs that are mainly applied to feed grains. This temporary measure is announced and implemented each year. Adjustment tariffs on certain agricultural goods are also updated each year in consideration of price differences between domestic and imported products, market share and tariff differentials among similar products.

In addition to the TRQ for multilateral agricultural market-access commitments, country-specific TRQs were established, including Chile (7 products), EFTA (1 product), ASEAN (3 products), the European Union (10 products), Australia (7 products), Canada (7 products), the People's Republic of China (6 products), New Zealand (4 products), Columbia (1 product) and the United States (16 products). All quotas are agreed to be administered by auctioning methods.

Since its first FTA ratification with Chile in 2004 to 2016, Korea has concluded 15 FTAs with a total of 52 countries.[2] Korea's tariff concession across partner countries ranges from 55% with India to 98% with the United States. Rice is excluded from tariff concession in all existing FTAs, but significant tariff concessions for livestock and fruit products are included in some of the FTAs (Table 5.1). Tariffs on beef from the United States, Australia and Canada will be completely eliminated within 15 years of implementation. Tariffs on pork originating from the European Union, the United States, Chile and Canada will also be eliminated over a maximum of 10 years. Tariffs on chicken meat mainly coming from the United States, Brazil and the European Union will be abolished over 10 to 13 years of implementation. Other sensitive products are protected by maintaining current duties, setting up new country-specific TRQs, allowing seasonal tariffs or introducing Agricultural Safeguard measures (ASG).[3]

On the export side, the government is increasing its efforts to expand agri-food exports to reach USD 10 billion. The government selects competitive exporters and provides consulting and overseas marketing services. Diversification of export markets is promoted through the operation of export market-pioneering groups and quarantine negotiations. The government also promotes the exports of agriculture-related industries such as agricultural machinery through improving export statistics of agriculture-related industries and preparing a market information system to support exporters. Korea has been a net exporter of agricultural machines since 2009. Tractors account for around half of export and the United States is by far the largest export destination (KREI, 2015).

Table 5.1. Korea's tariff concessions on beef, pork and poultry meats with FTA partners

Products	Base tariff (%)	FTA Partner countries	2017 tariff (%)	Periods of tariff elimination after ratification
Beef	40	United States	24.0	15 years with ASG
		Australia	29.3	
		Canada	32.0	
Pork, fresh (bacon)	22.5	European Union	8.1	10 years with ASG
		United States	9.0	
		Australia	13.5	
		Canada	17.3	
		Chile	0.0	
Pork, frozen (bacon)	25.0	European Union	9.0	10 years
		United States	0	By 2014
		Australia	25.0	Excluded
		Canada	19.2	13 years with ASG
		Chile	0	10 years
Chicken, frozen (legs/breast)	20.0	European Union	7.2/10.0	10 years/13 years
		United States	8.0/10.0	10 years/12 years
		Chile	20.0	TRQ of 2 000 tons
		ASEAN	20.0	Excluded
Chicken, fresh (cuts/ginseng soup)	18-27	European Union	6.5/10.9	10 years
		United States	7.2/12.0	10 years
		Chile	18.0	10 years/TRQ of 2 000 tons
		ASEAN	18.0	Excluded

Source: Park et al. (2015).

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5.4. Domestic agricultural policy

The domestic price support programme

Korea had a government procurement programme for rice until 2004, with a procurement price higher than the market price. In 2005, the rice procurement programme was replaced by a public stockholding scheme and direct payment programmes. Government procurement programmes (operated by NACF) were also in place for barley, maize and soybeans.

The purpose of the public stockholding scheme is to secure the supply of major staples in the event of natural disasters or other unexpected circumstances which lead to a temporary grain shortage. The target amount of public stockholding for rice is around 17% of annual consumption (720 000 to 780 000 tonnes on a milled rice basis). To keep the stock in good edible condition, the government purchases half of the target amount during the harvest season and releases the same amount during the non-harvest season each year. Purchase quantities for public stockholding are determined through a cabinet meeting and the result is announced to the public (OECD, 2017c). In 2014 and 2015, public stock purchases of rice from domestic farmers amounted to 370 000 tonnes and 360 000 tonnes, which represented around 8.7% and 8.3% of domestic production, respectively. The quantity of the government purchase programme for soybeans has increased in recent years in line with efforts to increase self-sufficiency in soybeans and to encourage crop diversification away from rice.

The high level of commodity-specific support to rice boosted its production, but dietary change in Korea is reducing its consumption. To address the oversupply problem, in 2017 the government announced a supplemented plan to balance supply and demand of rice by 2019 through a range of policy measures, adjusting its initial plan of 2015. Under the plan, the area of rice paddies will be reduced from 799 000 ha in 2016 to 711 000 ha in 2018 while encouraging crop diversification and the planting of high-quality instead of high-yield variety seeds. To expand rice consumption, the government intends to strengthen R&D investment in rice food processing industries and reinforce dietary education on the nutritional value of rice. It increased the release of public rice stocks for feed use from 90 000 tonnes in 2016 to 410 000 tonnes in 2017. The government also plans to provide rice to ASEAN countries through the ASEAN Plus Three Emergency Rice Reserve. Additionally, current rice policies, such as direct payments, the public stockholding scheme and farmland use regulations, are to be re-examined to optimise the level of production.

While Korea faces an oversupply of domestic rice, the supply of upland crops such as barley, soybeans and wheat is mostly based on import. In 2015, the self-sufficiency ratio of rice was 101%, but that of upland crops was only 10.6%. In 2016, the government established a long-term plan to increase the self-sufficiency ratio of upland crops to 15% by 2020. To increase production of upland crops, the plan promotes diversified cropping in rice paddy and mechanisation of upland farming; it also increases the quantity of government purchase for soybeans. Additionally, the plan includes measures to expand demand for upland crops by promoting the transfer of technologies and commercialisation using processing technology developed by public research institutes.

The price stabilisation activities for vegetables are funded by the government-financed Agricultural Products Price Stabilisation Fund as well as revenue from two activities managed by the Korea Agro-Fisheries and Food Trade Corporation: the sales of products purchased domestically for buffer stocks and the mark-up on imports of state traded items

such as beans, soybeans, potatoes, onions and garlic. Price stabilisation operations are sporadic, and the main crops affected have been dried red pepper, garlic and onions.

The dairy sector employs a production quota system. The current dairy policy was instituted in 2002 after the creation of the Korean Dairy Committee (KDC) in 1999. The KDC was put in place to handle the marketing of milk between producers and processors. Producers of milk were assigned a quota for milk production based on their production in a base period. Deliveries within 106% of the quota amount receive an in-quota price, with production between 106% and 117% of quota receiving 70% of the in-quota price. Deliveries over 117% of quota receive a price close to the import (world) price. In 2016, 24% of milk deliveries were made through the KDC, with the rest made through a number of different marketing organisations. These other marketing groups typically have a pricing structure that is similar in nature to that of the KDC.

Programmes to support farm income or reduce cost

Korea implemented its first direct payment programmes in 1997. The early retirement payment is a lump-sum payment for farmers between 65 and 74 years of age who are willing to sell or rent their land to full-time farmers below 64 years old or those under the age of 50 who have been working as farmers for more than three years. The rate of the payment is calculated as the difference between annual farming income and rent for the latest three years. From 2018, the rate of the payment will be differentiated between sale and rental of land (KRW 3.3 million (USD 2 915) and KRW 2.5 million (USD 2 211) per ha up to 4 ha, respectively). The period of payment is two to ten years, depending on the age of the retiring farmer.

The most important direct payment is the rice income compensation scheme, introduced in 2005 as a consequence of rice negotiations to allow more rice imports in the previous year. This scheme includes both fixed and variable payments. While the fixed payment is decoupled from current rice production and prices, the variable payment is determined according to the difference between a target price and each year's harvest-period price. If the harvest-period price is lower than the target price, farmers receive 85% of the difference, with a deduction of the fixed payment. The target price is set every five years based on the five-year price change; for the period 2013-17 it is KRW 188 000 per 80 kilogrammes (USD 2 025 per tonne) of rice, which is an increase from KRW 170 083 (USD 1 832) for the period 2005-12.

The government also supports rice processing complexes (RPCs) to encourage product differentiation and quality improvement in the rice market. For an RPC larger than 10 000 tonne/year, the government subsidises KRW 3 billion (USD 2.6 million) when it modernises its processing facility. In addition, the government provides an extra subsidy for 1) constructing storehouses and a drier, and 2) consolidating two or more RPCs to induce the gains from economies of scale (MAFRA, 2017).

Direct payments for upland farming were introduced in 2012 as a result of the FTA with the United States. The goal of the policy is to support the income of upland crop farmers and increase the self-sufficiency rate. The number of upland crops covered in the programme increased from 19 in 2012 to 26 in 2013, expanding to all upland crops in 2015. In 2016, KRW 161.1 billion (USD 138.8 million) was paid to 614 000 farmers. The amount paid per unit area differs depending on whether or not the area is an agricultural promotion area. In 2017, KRW 575 530 per ha was provided for agricultural promotion areas, and KRW 431 648 for non-promotion areas.

In general, the production scales of non-rice field crops are small, and many of them are marketed without any brands. The Upland Crop Joint Management Body Support Project provides subsidies for groups of producers who have merged into a jointly managed corporation that jointly produce and manage farmland of 50 ha or larger. The government provides an additional support for education, consulting, equipment and machinery and facility construction under the project (MAFRA, 2017). The Korean government is also implementing upland infrastructure maintenance projects to increase the competitiveness of crops such as fruits and vegetables, and to diversify agricultural production. The investment includes water source development, road building and management.

To mitigate the adverse impacts of trade opening in agricultural products through FTAs, Korea introduced a series of measures to assist farmers to adjust to the new market environment. Major programmes set up in 2008 under the Special Act on Assistance to Farmers and Fishermen comprise income compensation payments and payments for exiting farmers. The income support payment is contingent on three parameters: domestic market price, total imports and imports from FTA partner countries. First, the domestic average price of the particular product must be lower than 90% of the last five years' Olympic Average price. Second, imports of the product must exceed its base total import calculated on a 5-year Olympic Average basis. Finally, imports of the product from FTA partner countries must exceed the base import estimated by multiplying the 5-year Olympic Average import by the so-called import damage-triggering parameter (which is 1.05, 1.10, or 1.15 depending on market shares). The compensation payment scheme covers 95% of a price gap between the reference price and the current average price. Payment ceilings are KRW 35 million (USD 30 000) for individual farmers or KRW 50 million (USD 43 000) for agricultural enterprises.

Eligibility for exit payment includes not only requirements for income compensation payments, but an additional criterion, namely irreparably high investment costs or a period of two years or more of farming to generate profits. Support for exiting farmers amounts to three-year net income earned from the eligible items. Both income support payments and the exit payment are time-limited measures, running up to 2025 and 2020, respectively. In 2016, the government provided direct payments for carrots, grapes and blueberry farms and support of exit for grapes and blueberry farms (Table 5.2).

Table 5.2. Beneficiary agricultural products of the FTA compensation programmes

Year	Income compensation payments	Exit payment
2004-08	-	Greenhouse grapes, peaches, kiwis
2013	Korean native cattle and calves	Korean native cattle
2014	Sorghum, potatoes, sweet potatoes, Korean native calves	Korean native calves
2015	Soybeans, potatoes, sweet potatoes, melons, cherries, outdoor grapes, greenhouse grapes, chestnuts, chicken meat	Cherries, outdoor grapes, greenhouse grapes, chestnut, chicken meat
2016	Carrots, outdoor grapes, greenhouse grapes, blueberries	Outdoor grapes, greenhouse grapes, blueberry
2017	Balloon flower root	-

Source: Song et al. (2017).

In 2016, the Act was amended to introduce a co-operation fund to support the agriculture and fisheries sectors that could be adversely affected by trade liberalisation through FTAs. The fund will be financed by the industries that are likely to benefit from it. The Act aims to raise funds up to KRW 100 billion (USD 86 million) annually through voluntary contributions of private companies, which can receive tax benefits in return. The fund will be used to provide education to youths from farm households and to improve rural welfare and development.

Programmes to support risk management of farms

The agricultural insurance scheme, introduced for cattle in 1997 and for apples and pears in 2001, has increased its product coverage to 69 items: 53 crops and 16 livestock products (Table 5.3). Subsidising 50% of the insurance premium, public spending on the insurance scheme has increased from KRW 9 billion (USD 8 million) to KRW 287 billion (USD 247 million) since 2001. Currently, several private companies – NongHyup, KB and Hanwha, Dongbu and Hyundai – offer livestock insurance. The central and local governments co-finance premium subsidies at 70-85% (50% by central government and up to 35% by local government).

The coverage of livestock insurance includes dead animals and those slaughtered in emergencies, damage to facilities accommodating livestock and related buildings including peripherals. The highly concessional terms led to a considerable expansion of livestock insurance. Between 2011 and 2015, its penetration increased from 55% to 91% of total livestock numbers (of 16 types covered by insurance) (OECD, 2017b). Over the same period, the claims-to-premiums ratio rose from 60% to 98%. The majority of claims concerned animals lost to disease and emergency slaughter; these claims amounted to 90% of the total value of claims made in 2012 and 86% in 2015. The livestock insurance scheme covers the risk related non-notifiable diseases, but Korea also provides various types of support to producers, and in certain cases also to upstream and downstream businesses in the event of notifiable disease outbreaks (Box 3.3).

Table 5.3. Agricultural insurance in Korea

	Disaster insurance for agricultural crops	Disaster insurance for livestock
Applicable Act	Agricultural and fishery disaster insurance act	
Introduction year	2001	1997
Target item (2017)	Apples, pears, rice, and others (53 item)	Cattle, pigs, chickens, and others (16 item)
Main contract	Hurricane (strong wind), hail, etc.	Wind, flood, snow damage, disease, fire
Special contract	Freezing and frost injury, heavy rain	Housing (wind, flood, sea damage), electrical equipment risk
Comprehensive risk method	Natural disasters	-
Compensation level	Guaranteed 60% to 90% of the purchase amount	60% ~ 100% levels of market price
Support of national treasury	Premium 40~60% Operating expenses 100%	Premium 50% Operating expenses 50%
Supported budget	KRW 216.2 billion	KRW 62.8 billion

Source: MAFRA (2014b), Strategies for the Development of Prevent and Respond to Agricultural Disasters Caused by Climate Change, p.12.

As the existing agricultural insurance scheme covers only production risk, a pilot project for an agricultural revenue insurance scheme which also covers price risk was introduced for onions, soybeans and grapes in 2015. The number of commodities covered subsequently increased to six, with garlic added in 2016 and potato and sweet potato in 2017.

Box 5.2. Taxes on Agricultural Income in Korea

Agricultural income has an exceptional status in the Korean taxation system. Income from plant growing was subject to agricultural land tax until 2000 and to agricultural income tax between 2000 and 2009, both of which were local taxes. However, neither tax generated notable revenue after the revision of the former in 1985 and the suspension of the collection of the latter for five years from 2005 (Kim, 2013). The agricultural income tax was abolished in 2010 on the grounds that revenue from it was too low even to cover the costs of its administration. By contrast, income from livestock holding has always been subject to general income tax, which is a national tax.

After the abolition of agricultural income tax in 2010, income from plant growing was categorically exempted from income taxation until the end of 2014.The income tax code was amended in 2013 so that income from plant growing is to be taxed if the revenue is equal to, or more than, KRW 1 billion (USD 0.9 million). This taxation was applied for the first time to income of 2015. However, income from the production of grains and other human food crops is still categorically exempted from income taxation.

Another important tax treatment for agricultural income is provided to agricultural enterprises. Although most agricultural production is carried out by family farms in Korea, the government is also applying policy measures to foster corporate enterprises which could contribute to specialisation, professionalisation, and economies of scale in the sector. The income of these enterprises from edible crops for human consumption is exempted from corporate income tax. Furthermore, the dividend from such enterprises is fully or partially exempted from personal income tax and the part of the dividend that is not exempted is taxed separately from other types of income.

5.5. Agri-environmental policy

Currently no environmental regulations are imposed specifically on agricultural production except for the regulations on livestock manure. The majority of regulations in the agricultural sector are regulations on products and processes such as regulations on food safety, labelling of origin, and traceability (see Chapter 3.2). Compared to the United States and the European Union, environmental regulations in Korea have a relatively short history. However, Korea has gradually developed a comprehensive environmental regulation system which includes both command-and-controls and incentive systems. Environmental regulations have effectively contributed to internalizing pollution externalities, although some areas continue to require substantial improvements. The agricultural sector also has been under the general environmental regulation system, but not under stricter regulations than other sectors. Indeed, the polluter pays principle has been applied less rigorously to the agricultural sector, one reason being that the production scale of the average farm household is small, and most farms are earning a smaller income than urban workers. Thus, subsidies rather than regulations are preferred as environmental instruments for controlling agricultural source pollutions (Kwon, 2013).

Nevertheless, controlling the environmental impacts of agriculture and the sector's effects on natural resources is still important because it occupies 20% of total land of the country and accounts for almost half of total water withdrawal. The government first launched the Environment-friendly Agricultural Development Plan in 2001. The plan, which introduced the sustainability paradigm of the Rio Summit to Korean agricultural policies, has been updated and revised every five years. A new five-year (2016-20) promotion plan for environmentally friendly agriculture aims to expand market size for environmentally friendly agricultural products from KRW 1.4 trillion (USD 1.2 billion) to KRW 2.5 trillion

(USD 2.1 billion) between 2015 and 2020. The government plans to increase the share of pesticide-free (including organic) cultivation area from 4.5% to 8% and more generally to reduce the input of chemical fertilisers and pesticides in crop production by 1.5% per year. It will do so through measures including organic fertiliser support and strengthening the current direct payment for the promotion of environmentally-friendly agriculture. From 2017, only the private sector can provide certificates for environmentally friendly agricultural products – these had previously been provided by both public and private sectors. In addition, agricultural environmental protection programmes will be introduced for soil conservation and water quality improvement.

Promotion of environmentally friendly agriculture

To respond to increasing consumer interest in environmentally friendly agriculture, the Environment-friendly Agricultural Product Certification System was introduced in 2001. This system certifies agricultural products with minimum use of or without pesticides, chemical fertilisers and antibiotics and antimicrobials. The NAQS runs the system with the assistance of private inspection agencies. Certified products are classified into organic agricultural products and pesticide or antibiotic-free agricultural products.

Organic agricultural products have to be produced without using any pesticides or chemical fertilisers while pesticide-free products are produced without using pesticides but with the use of less than one-third of the recommended amount of fertilisers. Organic livestock products and antibiotic-free livestock products have to be produced without using antibiotics, synthetic antimicrobials, and hormones. Organic livestock products must satisfy the additional requirement of using only organic feed.

Korea introduced the Environment-friendly Agriculture Promotion Act in 1997. This programme introduced direct payments for environmentally friendly farming in 1999 to temporarily compensate for the reduction of yields brought by the adoption of environmentally friendly farming practices in both crop and livestock production. In 2017, 30 453 crop farms and 1 485 livestock farms that produced organic and pesticide-free products received total payments of KRW 32.4 billion (USD 28.7 million). The programme is linked to the Environment-friendly Agricultural Product Certification System, as only farm households or farm corporations certified by the system can be the recipients of the payment. The payment is given up to five ha and limited for five years for certified organic production and three years for pesticide-free production. The payment to an organic farm can be extended at a lower rate provided that the farm continues its organic production.

The Environment-friendly programme was expanded to organic or antibiotic-free livestock product farms in 2009. Producers with a Hazard Analysis and Critical Control Points certification and a certification of organic or antibiotic-free animal production are included in the payment system. The payment is limited for five years for organic livestock production and three years for antibiotic-free production.

Promotion of biodiversity and rural amenities

The Biodiversity Management Contract Policy supports contracts between local government and rural residents under which the government pays for residents' ecosystem conservation activities. The policy is composed of two programmes. The Cultivation Management Contract pays for a farmer cultivating barley or other crops under the contract and feeding migratory birds. The Conservation Activity Management Contract pays for

farmers leaving grains and straw on fields and making animal shelters. In 2016, 24 cities and towns participated in the programmes.

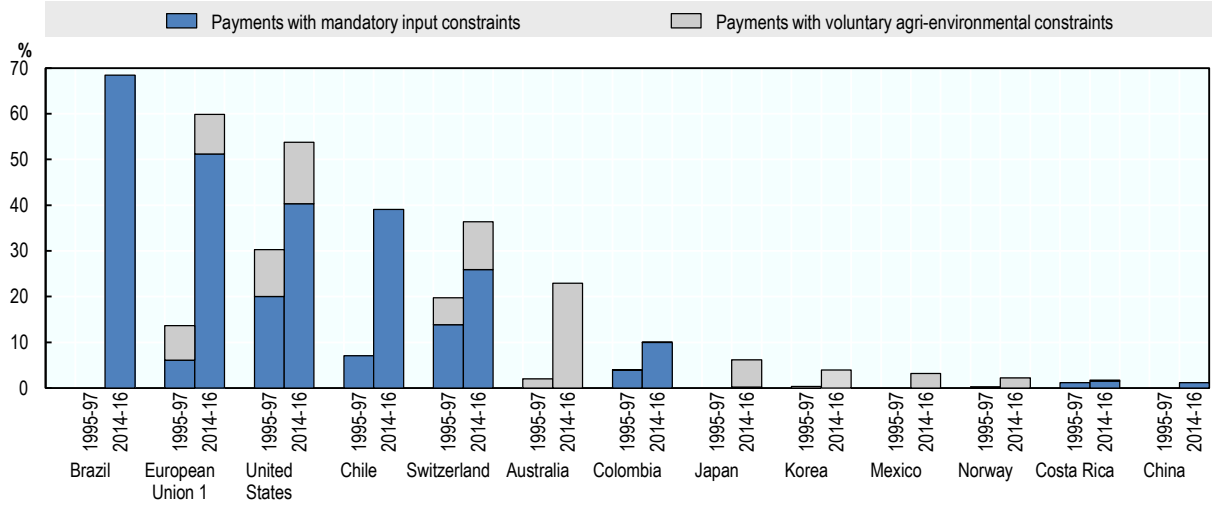
The amenity value of Korea's rural areas is increasingly recognised. The Direct Payment for Landscape Preservation was introduced in 2005 to enhance rural amenity value by increasing cultivation of amenity crops and stimulating rural village amenity-preservation activities. The payments compensate for the services that rural residents provide under a contract between a group of farms and a local government to cultivate amenity crops collectively. The programme pays KRW 1.7 million (USD 1 460) per ha for amenity crops (KRW 1.0 million (USD 860) per ha for similar crops) and MAFRA and local governments share the cost evenly. In addition, KRW 0.15 million (USD 130) per ha is paid for the other activities of village landscape preservation. The programme paid KRW 9.8 billion (USD 8.66 million) for 10 141 ha in 2015.

A direct payment programme for less favoured areas was introduced in 2004 on a pilot basis to support producers in geographically handicapped areas with low productivity and poor living conditions, and became a national programme in 2006. Its budget increased from KRW 10 billion (USD 8.7 million) in 2004 to KRW 39.5 billion (USD 34.1 million) in 2016 and the participating areas increased from 29 507 ha to 104 931 ha over the same period. The programme pays KRW 0.55 million (USD 470) per ha and KRW 0.3 million (USD 260) per ha for cropland and grassland, respectively.

As a result of introducing a series of agri-environmental payments, the share of producer support with voluntary or mandatory agri-environmental constraints in Korea has increased from 0.4% in 1995-97 to 3.9% in 2014-16, but it is still much lower than that of the European Union and the United States, in which a majority of the payments have such environmental conditionality (Figure 5.7).

Figure 5.7. Support linked to agri-environmental constraints, 1995-97 and 2014-16

As a percentage of Producer Support Estimate



Note: Countries are ranked according to 2014-16 levels.
1. EU15 for 1995-97 and EU28 from 2014.
Source: OECD (2017a), "Producer and Consumer Support Estimates", *OECD Agriculture statistics* (database), http://dx.doi.org/10.1787/agr-pcse-data-en.

StatLink https://doi.org/10.1787/888933851951

5.6. Policy to promote the food industry

The Korean government is increasing support to foster its food industry. The Food Industry Promotion Act was enacted in 2007 to strengthen the linkage between the food industry and agriculture, to promote the development of the healthy food, and to enhance the competitiveness of the food industry. Policies to promote food industries include strengthening food R&D support, expanding professional workforce training, fostering small and medium food companies, industrialising traditional foods, providing food industry statistics and information, standardisation of food, establishing national food industry clusters, fostering the food service industry, promoting Korean food and food tourism, and expanding exports of agricultural products.

Investment supporting food R&D has continued to expand since 2010, when food R&D became independent of other budgets. By supporting food R&D, the government intends to enhance linkages between agriculture and the food industry, increase export competitiveness of the food industry, create new demands for agriculture through responding to the change of food consumption trends and enhance competitiveness of the food industry. The budget for supporting food R&D increased from USD 16 million to USD 30.2 million in 2010-16.

Since 2010, the government has implemented policies to foster R&D and export-oriented "global hubs for food markets in Northeast Asia" by creating national food clusters integrated with food companies, research institutes, and affiliated companies. The Korea National Food Cluster (Foodpolis), an R&D-focused and export-oriented platform established within an area of 2.32 square kilometres, was completed by 2017. To support food companies that purchased or rented land, the government has been operating specific R&D facilities from early 2017: a food functionality assessment centre, a food quality safety centre and a food packaging centre. Companies in the cluster can benefit from a range of subsidies and tax exemptions. In particular, foreign investment companies are eligible for the reduction or exemption of site rental for up to 50 years if they fulfil certain requirements such as on the size of investment or the level of technology. As of March 2017, 29 Korean food companies and 2 foreign investment enterprises had signed agreements to move into Foodpolis and were in the process of constructing their plants.

Two main programmes are employed to train the professional workforce: customised training programmes and an integrated job information system. In the customised training programmes, step-by-step approaches are applied. The first step is online education which includes general education (management, marketing, etc.), food-related education (industrial trends etc.) and trend education (newly created jobs, etc.) for people who are to be employed in the food industry. The second step is job competency training for food industry employees and job seekers. The third step is education customised to young people, based on a curriculum involving field experience, company participation and active engagement.

The integrated job information system provides jobs as well as specialised job search information for the food sector, customised job analysis, education management, employment and education history management, and job matching. The system manages integration with existing sites such as WorkNet, with other institutional education programmes, and with human resources databases. It establishes employment information and customised job connections for food and restaurant companies such as those in national food clusters and Halal-related food enterprises.

5.7. Summary

With the remarkable economic growth of the last decades, Korea's agricultural sector has experienced a number of structural challenges in a very short period. Multilateral and bilateral trade agreements have also forced some parts of the agricultural sector to adjust to a more competitive market environment. The objective of agricultural policy in Korea has evolved from a stable supply of staples and self-sufficiency in rice to more diverse objectives: competitiveness along the food chain, the environmental sustainability of agriculture, erasure of the income disparity between rural and urban households, and the qualitative improvement of rural life. The most recent five-year policy plan of 2018-22 emphasised the re-orientation of agricultural policies to ensure income stability and quality of life of farmers as well as the balanced development between agricultural production and environmental conservation, aiming to address varieties of societal demands towards agriculture and rural areas.

According to the OECD PSE/CSE database, Korea grants one of the highest levels of support and protection to its farmers among OECD countries. Although Korea has increased investment in the agricultural knowledge and innovation system and introduced payments that are decoupled from current commodity production, the overall portfolio of agricultural policy in Korea is dominated by policies that are linked to staple production and to supporting farm income. Korea could further reallocate public resources towards investments better geared to increase long-term productivity growth and sustainability in agriculture.

The level of producer support in Korea declined gradually from 70% of gross farm revenue in 1986-88 to 49% in 2014-16. However, the transfer to single commodity production still accounts for more than 90% of transfers to individual producers. This structure of support may constrain farmers' responses to market signals, hinder structural adjustment of the sector toward production of more value-added products and increase environmental pressure from agriculture. Reform in agricultural policy to move away from intervention coupled with commodity production and towards more flexible support on what to produce would facilitate the structural change toward more market-oriented agricultural production.

Income from the production of grains and other human food crops in Korea is categorically exempted from income taxation, and income from plant growing is not taxed if the revenue is less than KRW 1 billion (USD 0.9 million). In addition to commodity-specific support, this preferential income tax treatment could prevent resource allocation towards more profitable and competitive agricultural sectors. Moreover, such exemptions reduce farmers' incentive to record and manage their farming business activities through bookkeeping. The lack of an income tax record constrains the government's ability to design more targeted policy to address low income or income variation issues. For example, low-income farmers find it difficult to benefit from the income safety net programme (the National Basic Livelihood Guarantee). The introduction of more targeted income-contingent payments or tax incentives to smooth income fluctuation is administratively difficult to implement in Korea.

Currently, agricultural policies, in particular the commodity specific support to rice, function as a social safety net for small-scale and aged farmers. While the rural development policy and general social security system should play a major role in addressing the issue of farm households' low income, agricultural policy should focus more on supporting the improvement of productivity and the sustainability performance of large-size commercial farms. For example, reforms to reduce price support through border

protection and domestic measures would increase the role of income support payments targeted to commercial producers. A more open market environment is likely to increase the demand for tools to manage unexpected and unavoidable income shocks. A programme offering payment in the event of a fall in commodity prices is currently in place for rice. Such payments should be gradually decoupled from specific commodity production and more targeted to commercial producers, who have a higher dependency on farm income.

The agricultural insurance scheme has increased its commodity coverage to 74 agricultural products. However, the programme is highly dependent on government subsidies. A high level of insurance subsidies may lead to unsustainable choices of production and farm practices in the short term, and to the adoption of maladaptive practices under a changing climate in the long term (OECD, 2016). In general, insurance subsidies risk crowding out market-based solutions and own-farm risk management strategies, and they may transfer to taxpayers a part of the risks that should be borne by farmers (OECD, 2011). The subsidy rate should be gradually reduced for more commercially viable insurance products. The role of the private sector in providing agricultural insurance services can be enhanced by making the existing insurance database accessible to private insurance providers.

Designing agri-environmental policies requires the definition of reference levels, and environmental targets play a crucial role in choosing policy instruments. Reference levels are the minimum level of environmental quality that farmers are required to provide at their own expense, and environmental targets represent a voluntary (desired) level of environmental quality. To establish a solid framework of agri-environmental policies, Korea should further clarify the reference environmental quality and environmental targets which are well adapted to the local ecological conditions.

In this context, Korea can give greater consideration to the promotion of environmentally friendly agriculture and the preservation of the ecosystem in a wider set of policy instruments. So far, Korea has implemented its long-term plans to improve the agricultural environment mainly through producer incentives such as abolishing input subsidies and providing direct payment schemes. However, there remains room for improving the environmental performance of the sector, such as high surplus levels of nitrogen and phosphate and water-use intensity in agricultural production. Environmental policies should increasingly build on the polluter-pays principle. Direct payment schemes should be more decoupled from production decisions and reoriented toward measures to target explicit societal objectives, such as the provision of environmental services including water management, flood buffering and biodiversity.

Notes

[1] Korea has declared two state-trading arrangements: MAFRA for the importation of rice within the tariff quota, and the Agro-Fisheries & Food Trade Corporation (AT) for the importation of a number of agricultural products (genus Capsicum, garlic, onions, sesame seeds, soya beans, green beans, small red beans, buckwheat, and ginger (WTO, 2016).

[2] The fourteen other bilateral and regional FTAs are Singapore (2006), EFTA (European Free Trade Association) (2006), ASEAN (Association of South East Asian Nations) (2007), India (2010), the European Union (2011), Peru (2011), the United States (2012), Turkey (2013), Australia (2014), Canada (2015), China (2015), New Zealand (2015), Viet Nam (2015) and Columbia (2016).

[3] For example, US fresh oranges face a seasonal tariff until it is gradually reduced and abolished six years after ratification. In the meantime, a TRQ of 2 500 tonnes with a 3% increase per year is offered. Similarly, Chilean grapes are subject to a seasonal tariff of 45% over the harvest period between May and October while an off-season tariff is to be removed over ten years. The tariff on US grapes from October to the following April is to be abolished over four years while the tariff on the other period is scheduled to be eliminated in 17 years.

References

GAIN-KS1613 (2016), "Korea – Republic of: Grain and Feed Annual", USDA FAS, 30 March.

Kim, Jungki (2013), "Advisory Report on the Proposal by the Government for Revision of Income Tax", Committee of Strategy and Finance, National Assembly.

Korea Rural Community Corporation (2014), *Statistical Yearbook of Land and Water Development for Agriculture*.

KREI (2018), *2017 Public Opinion Survey on Agriculture and Rural Areas*, Naju-shi, Korea

KREI (2015), *Agriculture in Korea*, Korea Rural Economic Institute, Naju-shi, Korea.

Kwon, O. S. (2013), *Environmental economics*, Pakyoungsa.

MAFRA (2017), *2017 Guidelines for Implementation of Projects.*

MAFRA (2014a). An On-line Policy Forum for TRQ Administration Methods. Press Release on October 1, 2014,

MAFRA (2014b), *Strategies for the Development of Prevent and Respond to Agricultural Disasters Caused by Climate Change*.

OECD (2017a), "Producer and Consumer Support Estimates", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-pcse-data-en.

OECD (2017b), "Case study in livestock disease management: Korea", in *Producer Incentives in Livestock Disease Management*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264279483-10-en.

OECD (2017c), "The Market Impacts of Policies Related to Public Stockholding of Rice in Asia: Part I", TAD/CA/APM/WP(2016)28/FINAL.

OECD (2016), *Innovation, Agricultural Productivity and Sustainability in the United States*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264264120-en.

OECD (2011), *Managing Risk in Agriculture: Policy Assessment and Design*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264116146-en.

Park, J.K., Ji, S.T., Han, S.H., Lee, H.K., Yoon, J.H. and Lee, S.H. (2015), "2014 Annual Report of Survey and Analysis for Agricultural Products that are Subject to FTA-Induced Damage Compensation Payments", Korea Rural Economic Institute, Seoul.

Song, W.J., J.H. Yoo and S.H. Myeong (2017), "An Analysis of Expressed Interest in Crop Switching by Shutdown Farms in 2016", Current Issue Analysis No. 33, Korea Rural Economic Institute, Seoul.

WTO (2016), *Trade Policy Review: Korea*, World Trade Organization, Geneva.

Chapter 6. Agricultural innovation system in Korea

This chapter describes the agricultural innovation system in Korea and outlines the recent changes it has undergone. It first provides an overview of the general innovation system; presents agricultural innovation actors and their roles in the system; outlines changes in roles and themes of R&D; and presents the main policy instruments and monitoring efforts. It then reviews the main trends in public and private investments in R&D, the funding mechanism and the means used to foster knowledge markets and networks. This is followed by an overview of policy incentives for the adoption of agriculture innovation, with an emphasis on the role of training and advisory services at farm level.

6.1. General characteristics of R&D in Korea

Performance

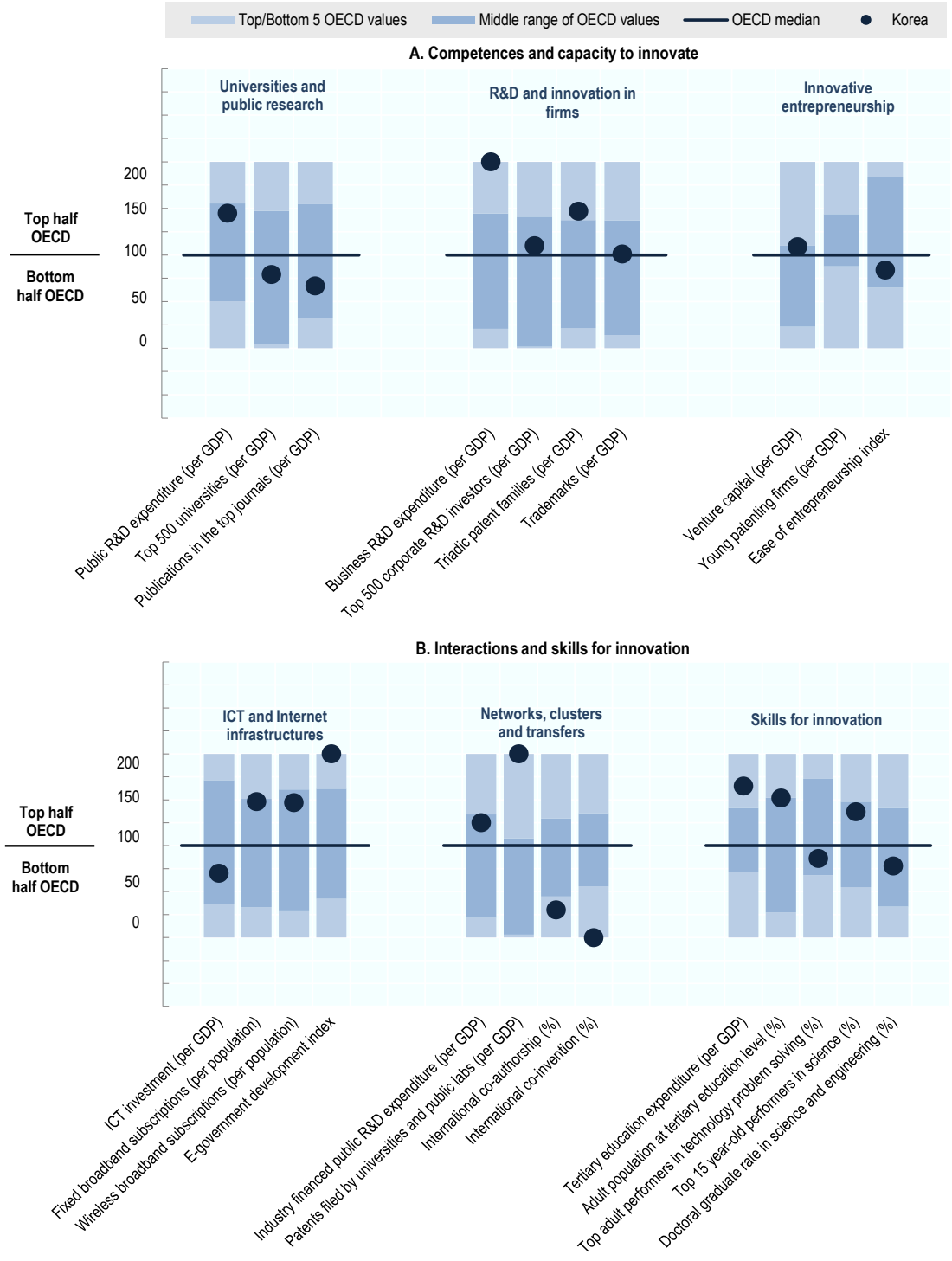
Korea's strategic objective is to shift its growth paradigm from that of an industrial economy to that of a knowledge-based one. The intensity of its public and private R&D expenditure is among the highest of OECD countries. Gross domestic expenditure on R&D grew 6.9% in 2009-14, reaching 4.3% of GDP in 2014. Publicly financed R&D expenditure, which grew by 4.1% annually in 2009-14, is 1% of GDP. Korea's business expenditure in R&D was 3.4% of GDP and at the top of the OECD ranking (OECD, 2017a). The government offers a generous tax credit programme to private R&D investment. Korea's tertiary education expenditure per GDP is also among the highest of OECD countries. The public research system has concentrated on applied and development-oriented research, much of which is performed in the public research institutes. The government has increased investment in basic research, from 30% of total government R&D investment in 2008 to 36% in 2015, with a target of 40% by 2017 (OECD, 2017a).

Despite this considerable investment in its R&D system, Korea has few world-class universities and produces fewer high-impact publications according to indicators such as the Top 500 universities per GDP, publication in leading journals and triadic patent families (OECD, 2017a). According to OECD statistics, its education sector performance is quite low relative to investment, both in terms of top adult performers in technology problem-solving and doctoral graduate rate in science and engineering (Figure 6.1).

Strong development in ICT sectors has been a key factor in making Korea one of the fastest-growing OECD economies over the past decade. It has a strong revealed technology advantage in ICT, with almost half of business R&D performed by the computer, electronics and optical industries (OECD, 2017a). The country's infrastructure for ICT and internet is more advanced than that of any other OECD country, particularly in terms of wireless broadband subscriptions and E-government development.

Figure 6.1. Comparative performance of Korea's science and innovation system, 2016

Normalised index of performance relative to the median values in the OECD area (Index median=100)



Source: OECD (2017a), "Korea", in OECD Science, Technology and Innovation Outlook 2016, http://dx.doi.org/10.1787/sti_in_outlook-2016-71-en.

StatLink https://doi.org/10.1787/888933851970

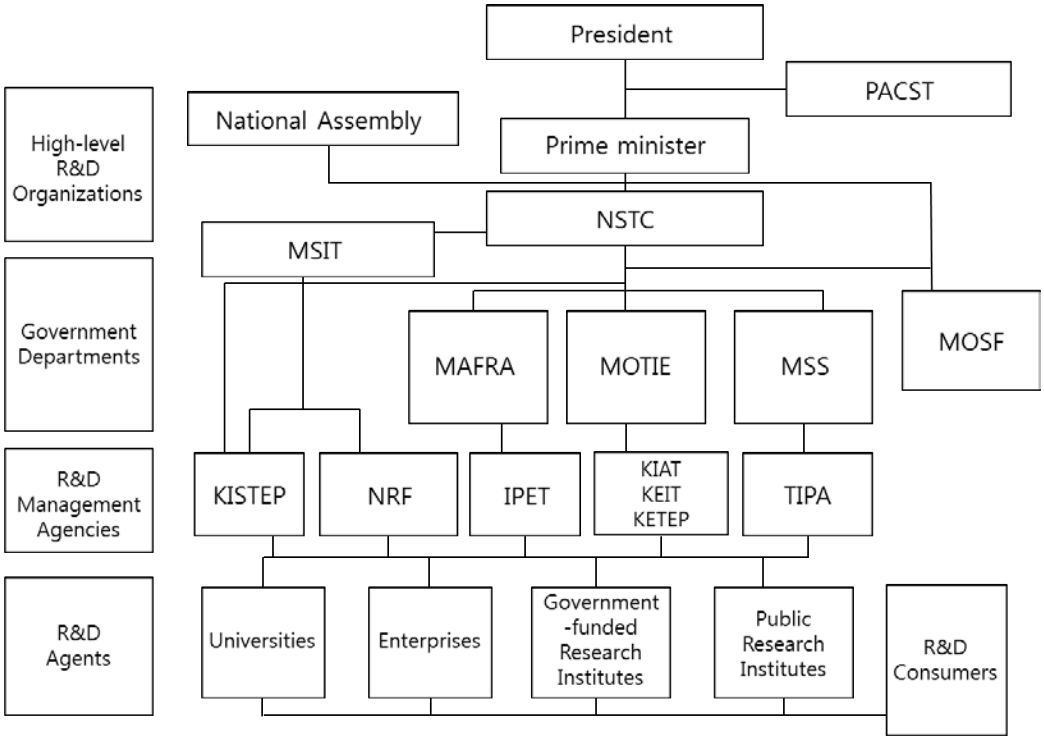
General governance of innovation

The Science and Technology Framework Law of 2001 includes provisions for the formulation of mid and long-term policies and implementation plans. It serves as the legal basis for inter-ministerial co-ordination of science and technology policies and R&D programmes. It also provides the overall framework of support for R&D activities and science and technology agencies, and the legal basis for fostering an innovation-driven culture (OECD, 2014a). The government formulates five-year Basic Plans for Science and Technology based on the Framework Law. The National Science and Technology Council (NSTC), under the Prime Minister's Office, is the top decision-making body in the science and technology sector, for which it deliberates key policies, plans, projects and budget operation (Figure 6.2). The council consists of the Prime Minister as the chairperson, 14 Ministers and 10 private-sector members, one of whom acts as co-chairperson. The Presidential Advisory Council on Science and Technology (PACST), established in 1989, provides advice and consultation to the President regarding science and technology development strategies, major policy directions and system improvement measures. From April 2018, NTSC will be merged with PACTS to consolidate the strategic planning organisations and make the decision-making process more efficient.

A ministerial overhaul and major changes in science and technology policy co-ordination arrangements were carried out in 2013. Most science and technology policy functions have been consolidated into the Ministry of Science and ICT (OECD, 2016a). The ministry (MSIT) is in charge of the establishment, supervision, adjustment and evaluation of national science and technology policies, including the Basic Plan for National Science and Technology. The Korea Institute of Science and Technology Evaluation and Planning (KISTEP) provides support for planning, evaluation, and management of national R&D. While the Ministry of Strategy and Finance (MOSF) allocates general R&D budget, ministries such as MAFRA, MOTIE and MSS implement specific R&D projects in co-operation with the co-ordinating institutions such as MSIT and NSTC.

Based on the Framework Act on Science and Technology, each implementing ministry has a specialised R&D management agency that plans, evaluates and manages the public R&D projects. Each of these agencies sets and supports national-level strategies and serves as a link between their respective ministries and R&D agents such as public research institutes and universities. The first R&D management institution was founded in 1977 to manage national projects: the Korea Science and Engineering Foundation, currently the National Research Foundation of Korea (NRF). As of 2017, a total of 19 R&D management institutions exist. For example, the Korea Institute of Planning & Evaluation for Technology in Food, Agriculture, Forestry and Fisheries (IPET) is the R&D agency for MAFRA.

Figure 6.2. Implementation framework of national R&D projects in Korea



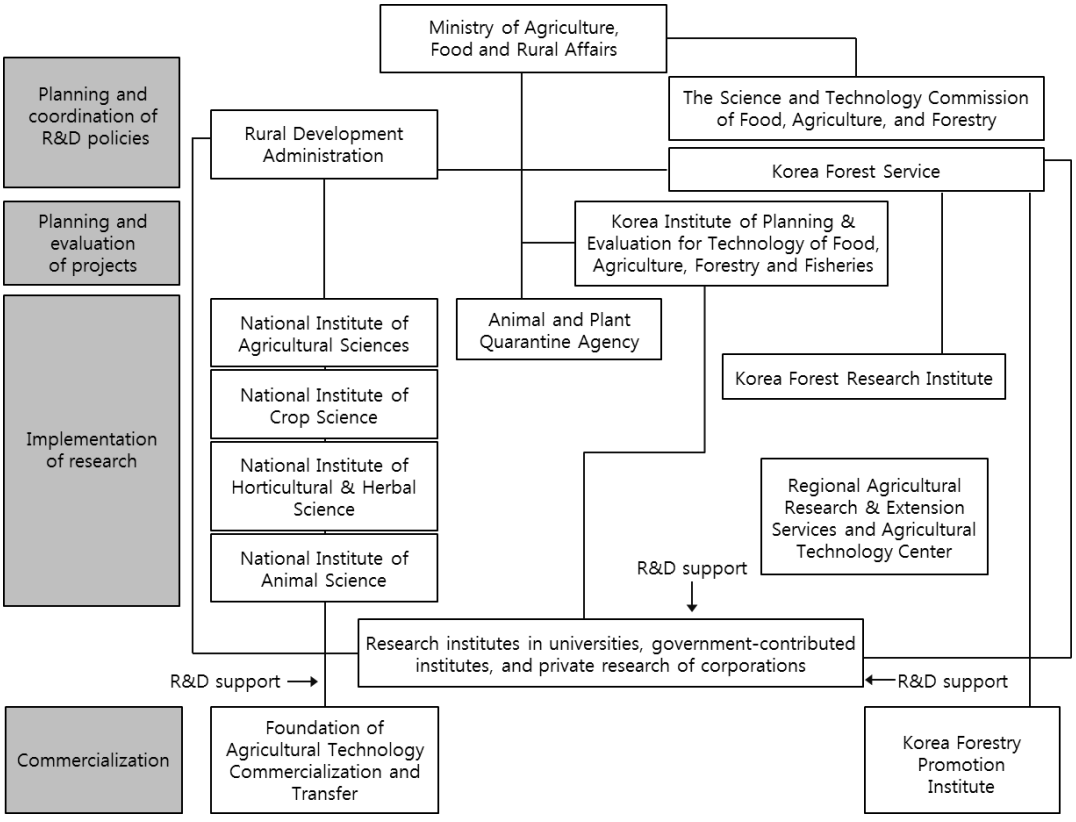
Note: KIAT, KEIT, KETEP and TIPA represent Korea Institute for Advancement of Technology, Korea Evaluation Institute of Industrial Technology, Korean Energy Technology Evaluation and Planning and Trade related IPR Protection Association.
Source: Kim et al. (2015), complemented. (Original source: Cho et al., 2003).

6.2. Actors, institutions and their roles in agricultural innovation systems

An agriculture innovation system (AIS) can be defined as the network of private actors such as farmers, producer organisations, agricultural enterprises and consulting agencies who intend to create new value through new agro-food, new production processes, new marketing, and new organisational forms; it includes public institutions at the central and local level.

In the agri-food sector, MAFRA, the Rural Development Administration (RDA) and Korea Forest Service (KFS) are responsible for planning and implementing R&D policies (Figure 6.3).[1] As MAFRA's main responsibility is the commercialisation of R&D outcomes in the agri-food industry and the development of private R&D capacity, applied and development research accounted for 29% and 56% of its R&D expenditure, respectively. Meanwhile, RDA is mandated to develop pre-industrialisation technologies, thus basic research accounted for 49% of its R&D expenditure in 2016.

Figure 6.3. National agri-food R&D system in Korea



Source: KREI (2015). (Original Source: Korea Institute of Planning & Evaluation for Technology in Food, Agriculture, Forestry and Fisheries, http://www.ipet.re.kr/Policy/Propel.asp. The content was partially complemented).

In 2009, the Science and Technology Commission of Food, Agriculture, and Forestry (STCA) was established as a control centre for efficient supervision, adjustment and management of R&D in the agri-food sector, which is managed by MAFRA, RDA and KFS. In addition to improving co-ordination of public agricultural R&D projects, STCA is also tasked with improving the linkage between policies and the direction of R&D.

The Korea Institute of Planning & Evaluation for Technology in Food, Agriculture, Forestry and Fisheries (IPET) is responsible for planning and supervising the competition-based R&D projects of MAFRA that are carried out by university research institutes, public R&D institutions, corporates, or private research institutes. Its major tasks include supporting the establishment of strategic and action plans to promote technological development in food and agriculture; supporting the planning, management, and evaluation of MAFRA's R&D projects; examining technological capabilities in the food, agriculture, and fishery sectors; and providing support for developing human resources in the related fields.

The Rural Development Administration (RDA) was established in 1962 to enhance the effectiveness of national agricultural R&D and technology dissemination, unifying the existing experimental research and technology dissemination system. RDA is in charge of planning and managing R&D projects implemented by the national research institutes, namely the National Institute of Agricultural Sciences, the National Institute of Crop

Science, the National Institute of Horticultural & Herbal Science, and the National Institute of Animal Science. The work of RDA includes planning and supervision of collaborative joint R&D projects by the national research institutes, universities, public R&D institutions and private research institutions. Unlike other research institutes, RDA performs both public R&D and extension services. The actual extension services are provided by the Agricultural Research and Extension Services at the provincial level and Agricultural Technology Centres at the municipality level. The Foundation of Agricultural Technology Commercialization and Transfer (FACT) was established under RDA to facilitate technology transfer for the agri-food industry, to create the foundation for commercialisation of agricultural R&D outcomes and to provide test services for quality certification.

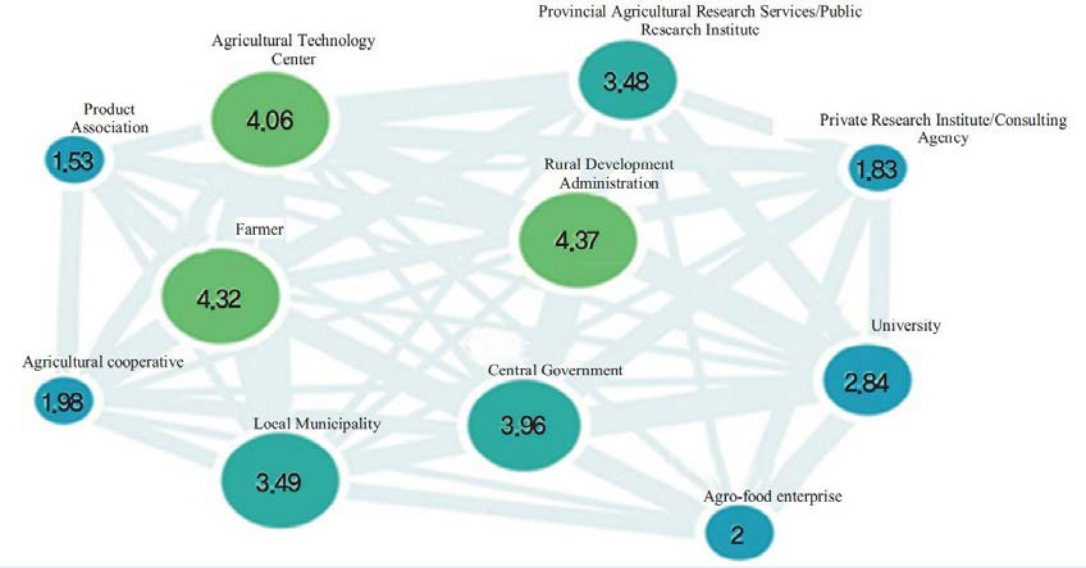
Regional research institutes include the Provincial Agricultural Research and Extension Services, which operates plant experiment stations specialised in locally grown cereals, fruits and vegetables. Agricultural Technology Centres, which are established in each municipality, carry out R&D related to on-farm application and extend the new technologies to the producers. However, improvement of co-operation between the central and local governments has been a policy issue. MAFRA and RDA are strengthening their collaboration with regional research institutes. For example, RDA is activating a national-regional co-ordination council at the planning stage of their R&D projects as well as national-regional research councils for each agricultural product.

As noted above, AIS actors include private entities such as farmers, agricultural product associations, enterprises, and agricultural co-operatives. The farmers' main role is to share knowledge and technology with other farmers and to apply technology for the production and marketing of agricultural products. Commodity-specific farmer associations often play a role in disseminating technology to their members, complementing the public extension service. They also communicate the technological needs of their members to public research institutions. NH also disseminates technologies and marketing strategy technologies to farmers, as well as supplying inputs and marketing outputs. Agri-business enterprises often both conduct R&D and communicate technological innovation needs to public research institutions.

Box 6.1. Network analysis of Korea's Agricultural Innovation System (AIS)

Lee et al. (2016) quantified the networking status among AIS participants (Figure 6.4). The width of the connection between the actors indicates its strength, while the size of the node represents the average influence of each actor. The network analysis of 11 AIS actors shows that public actors such as RDA, provincial agricultural research services and agricultural technology centres play a central role in Korea's AIS. On the other hand, private actors such as private research institutes, product associations, agro-food companies and agricultural co-operatives are relatively isolated from the public sector. This is an indication that the public-sector organisations need to strengthen their linkage with the private sector to develop a more inter-connected AIS. The network status of AIS also shows close relationships between RDA, the Provincial Agricultural Research Services and the universities. However, the weak relationship between the public R&D institutions and the central government, including MAFRA, shows that public R&D activities can further increase their linkage with national agricultural policy objectives.

Figure 6.4. Networking Status of AIS in Korea



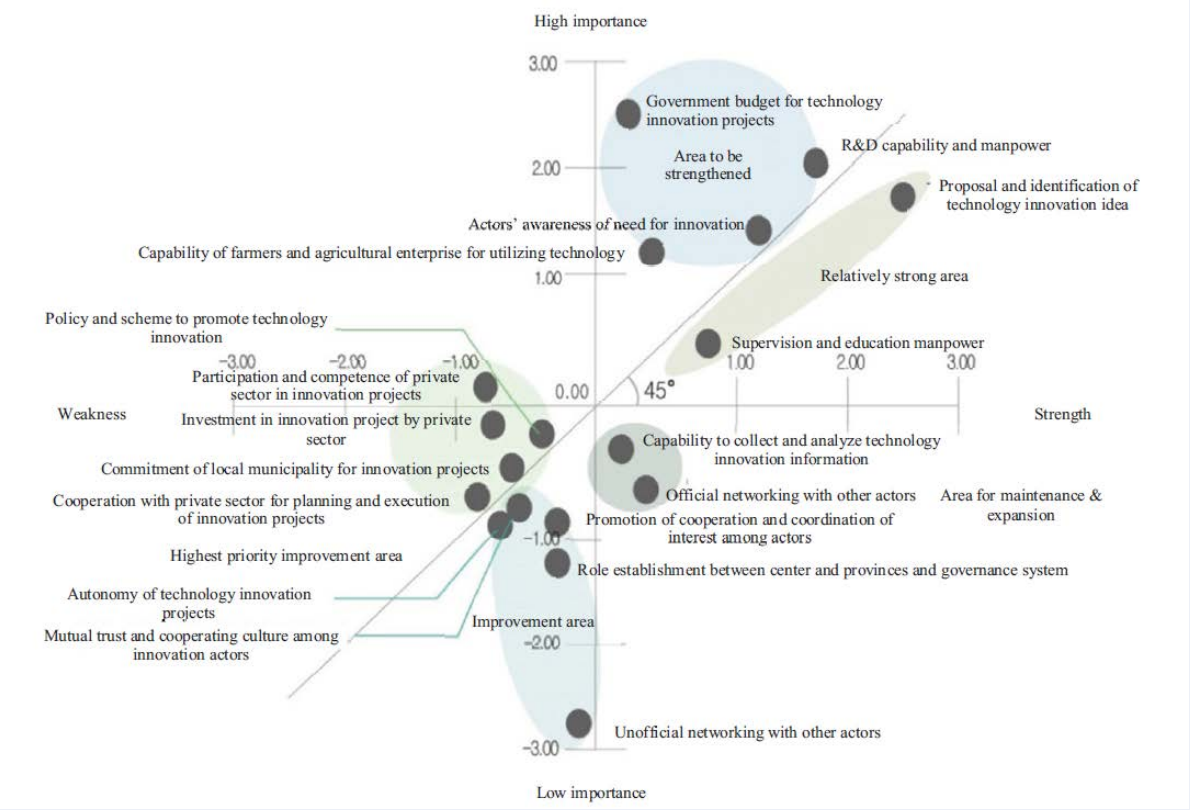
Source: Lee et al. (2016).

Lee et al. (2016) also conducted a survey among 11 AIS actors on 18 items of strengths and weaknesses as well as their importance (Figure 6.5).[1] The strengths of the Korean AIS in are identified as R&D capability and manpower, extension and education manpower, and government budget. Almost all actors identified awareness of the need for innovation as a strength, indicating a broad consensus among the actors on the importance of innovation. The proposal and identification of technology innovation ideas is selected as one of strengths, meaning that AIS actors are aware of what they need for agricultural technology innovation. Connecting the recognition of the need for innovation to substantial outputs from AIS is a major policy agenda in Korea.

However, the survey shows that co-operation with the private sector, private investment, and participation and capability of innovation in the private sector are identified as weak points. These items are also found in the 'Highest Priority Improvement Area', which a low performance score compared to their importance score. Moreover, co-operation between the

central and provincial government, policy and plan (scheme) to promote technological innovation, and co-operation and co-ordination of interests are shown to be weak, albeit to lesser degree. They are in the "Improvement Area", which is characterised by a low importance score relative to the performance score. The analysis indicates the future policy agenda should be to strengthen AIS, including by encouraging investment and participation of the private sector, establishing a culture of mutual trust and co-operation, clearly defining the roles of central and regional government, and expanding the autonomy of actors.

Figure 6.5. IPA portfolio for AIS



Source: Lee et al. (2016).

Note: 1. Items with a positive value are strengths while those with negative values are weaknesses. The level of strength or weakness of an item is higher as the absolute value is larger. The index is calculated as follows. Each respondent is asked to select three strengths and three weaknesses out of the 18 items. Selected strengths and weaknesses are given points. The score of each item is obtained by averaging the scores obtained from all the respondents. The same method was applied to measure the degree of perceived importance of 18 items. The area below the 45º line in the 1st quadrant is the 'Relatively Strong Area', meaning that the items in the area have a high performance score compared to their importance score. The 4th quadrant is the 'Retention Extended Area', meaning that the items in the area have high performance score but low importance score. The 3rd quadrant is the area of low importance and low performance. The area below the 45º line is the 'Improvement Area', meaning that the items in the area have a low importance score compared to their performance score.

6.3. R&D policy in agriculture

Strategic framework

The 1999 Act on Promotion of Science and Technology in Food, Agriculture, Forestry and Fisheries established the strategic framework for Korea's agricultural R&D policy, mandating the government to prepare a five-year Comprehensive Plan for Agri-food Science and Technology Development. A working group consisting of MAFRA, RDA, and KFS establishes the Plan, supported by 14 groups of technical committees of experts. Each technical committee proposes the major contents including the vision and direction of the plan, and the technical committee establishes a detailed roadmap for each technical field. The draft plan also reflects the results of the policy research conducted by KREI as well as the opinions of the general public as submitted through an online policy forum. STCA deliberates the draft of the plan, which is eventually endorsed at the national strategic level by the PACST.

Based on the Comprehensive Plan, MAFRA designs an annual implementation plan. For example, the implementation plan for 2017 highlights the significance of improving the R&D governance to minimise investment in similar and overlapping R&D projects run by MAFRA, RDA and KFS. It also recognises the need to re-allocate the roles and responsibilities of three organisations and to strengthen the function of the STCA. Since 2017, MAFRA and RDA have been jointly surveying demand for technology in order to improve the co-ordination of public R&D activities from the project planning phase.

The evaluation of R&D investment made by the 1st Comprehensive Plan (2010-14) highlighted the limitations in connecting agricultural policies and addressing on-site issues. Based on this assessment, the 2nd Comprehensive Plan (2015-19) aims to strengthen the link between policies and fields of activity and to increase the efficiency of the agri-food R&D. The Plan identifies 4 major areas and 50 core technologies (Table 6.1).

Table 6.1. Key contents of the 2nd Comprehensive Plan for Agri-food Science & Technology Development in Korea

Core Implementation Strategies		
R&D system innovation	Create an ecosystem for technology-based start-ups	Lay the groundwork for facilitating mid- and long-term R&D
1. Introduce a policy-R&D-field innovation model	1. Establish a commercialisation-oriented R&D system	1. Nurture human resources in the science and technology sector
2. Strengthen competitive, open, market-based R&D	2. Diversify financial support channels for start-ups	2. Expand the participation of the private sector in R&D
3. Establish a central-local R&D co-operation system	3. Build a technological start-up incubator system	3. Increase the access to technologies in the fields of activity of industries
4. Reinforce the R&D policy co-ordination function		
Expand R&D investment on core technology categories		
1. Expand investment in agri-food R&D		
2. Develop 50 core technologies in 4 categories to achieve agricultural policy goals		

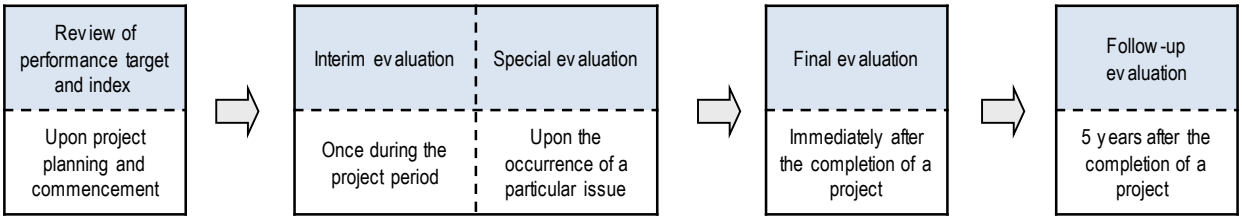
Source: MAFRA (2016).

Monitoring and evaluation system

The performance evaluation of R&D in the agri-food sector is conducted as a part of the national framework of R&D performance evaluation. Based on the Act on the Performance Evaluation and Management of National Research and Development Projects, MSIT annually formulates an implementation plan for the national R&D projects and institution evaluation, which is then reviewed by the Steering Committee of the NSTC.

Expanding the independence of researchers and conducting quality-based evaluation are considered the top priority to obtain excellent research outcomes. OECD (2014a) finds that few OECD countries are as comprehensive in evaluating public support for R&D as Korea. The performance evaluation system follows a five-step project cycle (Figure 6.6). It first sets a creative and challenging performance target and measures the qualitative excellence of the performance. Each ministry conducts an internal performance evaluation, followed by a higher-level evaluation by MSIT to examine the relevance and adequacy of the internal evaluation process and its results. MSIT also conducts special evaluations on projects that are relevant to particular policy issues or that require co-ordination with other projects. MSIT and NTIS publish the evaluation results and MSIT reflects these in the budget adjustment and allocation for R&D projects. Researchers who accomplish outstanding performance are rewarded by the government for their efforts with awards and increased R&D budget. MAFRA and RDA also use the internal performance evaluation result when revising and complementing implementation plans for R&D projects.

Figure 6.6. Performance evaluation system of national R&D projects in Korea



Source: MSIT (2017).

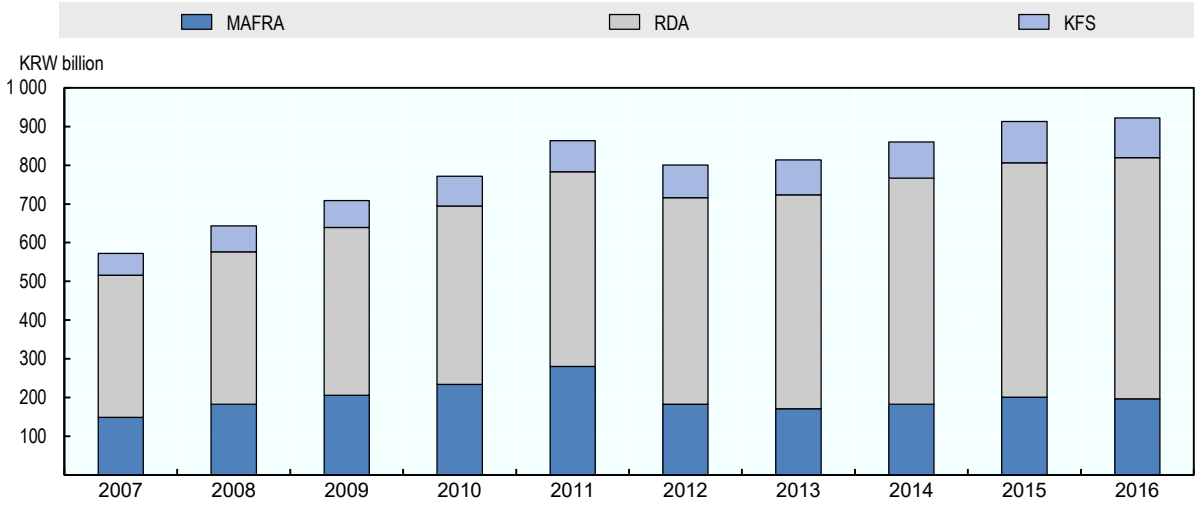
In 2017, interim evaluations were carried out on 129 projects conducted by 16 ministries and institutions, with a total value of KRW 5.3389 trillion (USD 4.5 billion). These projects will be rated on a five-point scale based on achievement of their predetermined performance target and excellence of their performance. In agriculture, the interim evaluation comprises four projects by MAFRA including the development of livestock disease countermeasure technology, and eight projects by RDA including the establishment of a climate change response system in agriculture. The final evaluation is conducted on the completed ten projects of six ministries and institutions. The follow-up evaluation is targeted at 15 projects of seven ministries and institutions completed in 2014-15. The level of post-performance management and relevance of the dissemination system are evaluated along with the impact and outcome of utilisation and distribution, including technology transfer and commercialisation.

6.4. Public and private investments in agriculture and food R&D

Public R&D investment grew at an annual average of 3.6% over the period 2012-16 (Figure 6.7). The growth rate of R&D expenditure was more than double the growth rate of three institutions' combined total budget. As a result, the R&D budget as a share of their total budget increased from 4.9% in 2012 to 5.5% in 2016. Among the three institutions, RDA accounted for 68% of public R&D investment and MAFRA accounted for 21% in 2016.

As a result of an increase in public investment in agri-food R&D, the intensity of government budget appropriations or outlays for R&D in agricultural science in Korea became one of the highest among the OECD countries, exceeding 3% of agricultural value-added in 2015 (Figure 6.8). The intensity of public R&D investment in agricultural science is also much higher than the intensity of other sectors in Korea.

Figure 6.7. Evolution of public investment in agri-food R&D in Korea, 2007 to 2016



Note: R&D in fisheries sector is included for years 2007 to 2012.
Source: NTIS (2017), National Science & Technology Information Service Database, http://rndgate.ntis.go.kr.

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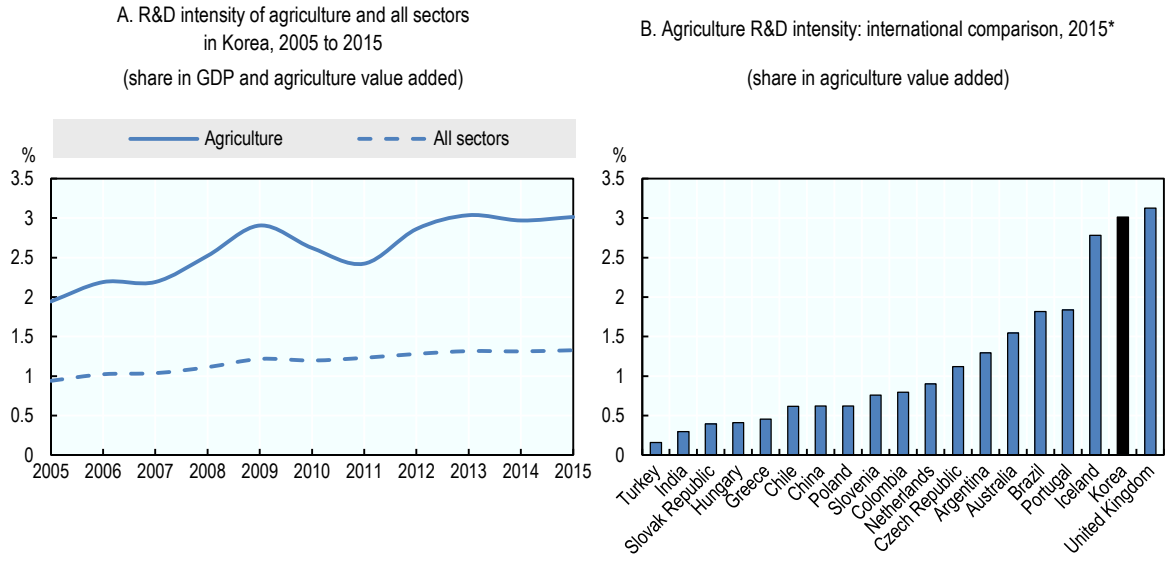
Public investment in agri-food R&D includes those projects directly performed by public research institutions (called "ordinary R&D projects") and competition-based R&D projects performed by external organisations such as universities, private enterprises, and public or private research institutes. Competition-based projects are selected for a specific research theme designated by a government institution or for an open theme suggested by a bidder. The percentage of competition-based projects in 2014 was 87%, 58% and 26% of the R&D expenditure in MAFRA, RDA and KFS, respectively (Table 6.2).

Figure 6.8. Intensity of public agricultural R&D investment

Government budget appropriations or outlays for agriculture and all sectors R&D as a share of value added



Note: * or latest available year.
Source: OECD (2017b), OECD Research and Development Statistics, Government budget appropriations or outlays; OECD (2017c), System of National Accounts, https://stats.oecd.org; ASTI (2017), Agricultural Science and Technology Indicators (2017), www.asti.cgiar.org/data (last accessed in October 2017).

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Table 6.2. Agri-food R&D budget in Korea, 2014

KRW million

		MAFRA				RDA (B)	KFS (C)	Total (A+B+C)
		IPET	APQA	Others[1]	Total (A)			
R&D expense	Competition-based (Practical & commercialisation-oriented)	160 471	2 831	4 298	167 600	277 949	19 664	465 213
	Ordinary R&D (Basic & fundamental)	..	24 818	..	24 818	201 312	56 299	282 429
	Subtotal	**160 471**	**27 649**	**4 298**	**192 418**	**479 261**	**75 963**	**747 642**
Personnel expense		4 541	4 764	..	9 305	103 140	17 083	129 528
Basic expenditure		3 090	640	..	3 730	9 692	2 752	16 174
Total		**168 102**	**33 053**	**4 298**	**205 453**	**592 093**	**95 798**	**893 344**

Note: 1. "Others" include rural development experiment research (1 718) and the policy R&D projects (2 580).
Source: Data provided by the Science and Technology Policy Department at MAFRA (partially complemented).

StatLink https://doi.org/10.1787/888933852426

The thematic focus of public agricultural R&D investment reflects the focus of the Comprehensive Plan for Agri-food Science & Technology Development. The current Plan (2015-19) has four major policy objectives: 1) Reinforcement of Global Competitiveness; 2) Creation of a New Growth Engine; 3) Stable Food Supply; and 4) National Welfare Improvement. The first objective of improving competitiveness includes research areas such as radical reform of agricultural industry, high value-added food and ICT

convergence, which accounted for 35% of public R&D investment in 2016. The second objective of creating new growth engines accounted for 30% of investment in 2016, including development of biotechnologies, golden seed projects and rural energy. The stable food supply objective attracted 22% of investment in 2016 and includes improving self-sufficiency rates, responses to climate changes, disaster and disease prevention. Welfare improvement includes safe food production and forest management. Public investment is generally focused on development of new technologies to improve competitiveness and productivity of agriculture, but it pays less attention to improvement in sustainability of agriculture.

Private investment in agricultural R&D

The intensity of private R&D investment, which accounted for 75% of total R&D investment in 2015, is the highest among OECD countries. The food and beverage industry in Korea also invests in R&D more intensively than other OECD countries, although less intensively than other sectors in Korea (Figure 6.9.B). According to the data provided by KISTEP, R&D investment by Korean food manufacturing reached KRW 953 billion (USD 842 million) in 2015, which is 3.9% of the value-added of the industry. Similarly, agriculture-related manufacturing industries including pesticide, agricultural machinery and fertilisers invested KRW 196 billion (USD 173 million) in 2015, which is equivalent to 7.6% of the industry's value-added. Private R&D investment by the food manufacturing industry and agriculture-related manufacturing industries grew by 3.5 and 1.9 times in 2008-15, respectively.

Despite a high overall level of private R&D investment in Korea, including by the food manufacturing and farm input industry, private investment in agriculture is very low (Figure 6.10.A). The share of private investment in agriculture is only 0.1% of agricultural value added, which is lower than most OECD countries. The growth of private R&D investment in agriculture was 1.5 times in 2008-15, which was significantly lower than other sectors (Table 6.3).

Table 6.3. R&D spending by agriculture-related enterprises in Korea, 2008 to 2015

KRW 100 million

	2008	2009	2010	2011	2012	2013	2014	2015
Agriculture	203	199	247	329	265	254	283	308
Food manufacturing	2 699	3 190	2 599	3 565	4 169	4 045	4 232	9 529
Agriculture-related manufacturing	1 039	1 186	1 217	2 433	1 726	2 646	1 908	1 955
Total	**3 941**	**4 575**	**4 063**	**6 327**	**6 160**	**6 945**	**6 423**	**11 792**

Source: KISTEP.

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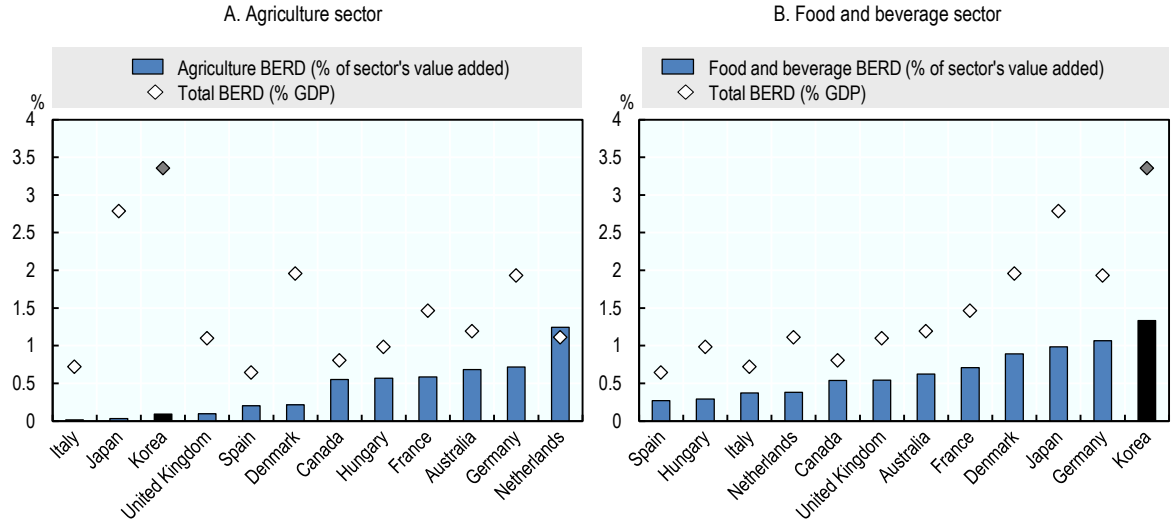
Figure 6.9. Business Expenditures on R&D (BERD) in the agriculture and food and beverage sectors



Note: The figures are based on the data for the latest available year for each country: the years 2013 and 2014 for the agriculture sector (panel A), except 2010 for Canada; the year 2010 for the food and beverage sector (panel B), except 2009 for Korea and 2006 for Australia.
Source: OECD (2016b), OECD Research and Development Statistics, Gross domestic expenditure on R-D by sector of performance and field of science, http://stats.oecd.org/Index.aspx?DataSetCode=GERD_SCIENCE; OECD (2016c), System of National Accounts, https://stats.oecd.org.

StatLink https://doi.org/10.1787/888933852027

Several factors may explain the particularly low level of private investment in agriculture in Korea. First, the primary agricultural sector is dominated by small-scale family farms, which have less capacity to invest in R&D. Moreover, the tax incentive for private R&D investment in primary agriculture is much less than in other sectors as most farmers and agricultural corporations are exempted from income tax. Second, the large public agriculture R&D programme is likely to offset the low private R&D, leading to Korea's overall intensity of total agricultural R&D investment being one of the highest among OECD countries. The high level of public R&D investment could reduce incentives for private R&D investment. It could also crowd in private R&D investment if public investment is designed as complementary to private investment.

The government can still improve the efficiency of public investment in agri-food R&D and reflect the demand for new technology and knowledge by further enhancing the linkages between public and private R&D. Increasingly, Public and Private Partnerships (PPPs) are considered as a tool to facilitate co-operation between various public and private actors (Box 6.2). In Korea, the government aims to increase the participation of private enterprises in government-led R&D projects. Public R&D funds are provided to the private sector in the form of matching funds for competition-based R&D projects. In this scheme, the minimum share of budget that firms need to finance depends on the size or type of the firm; 50% for large-sized firms, 40% for middle-size firms, 25% for small-size firms and 20% for agricultural corporations. As a result, the proportion of R&D projects in which private companies participate increased to 32% of public agricultural R&D projects in 2013.

In 2016, a pilot R&D voucher programme for agricultural ventures and start-ups was introduced, whereby the government provides a voucher to the technology customer (e.g. farmers and agricultural enterprises) to select the desired technology developer. When the technology developer presents the coupon to the government, they receive support with the cost of development. This programme is focused on short-term (1-2 years) technology development challenges, such as supplementation of existing technologies and the making of commercial prototypes.

The government is also increasing financial support for agricultural start-ups. For example, agri-food venture and start-up support centres have been created in each region. The centres build a co-operative network between relevant institutions in the agri-food sector while providing a customised matching system that start-up founders need for technology, funds and target markets. Private investment in technology-based start-ups is encouraged by dedicated support funds that match public and private capital, such as the R&D Fund (KRW 10 billion – USD 9.5 million – in 2014) and the Agri-food Start-up Idea Fund (KRW 12 billion – USD 10.6 million – in 2015). Moreover, an agri-food crowdfunding platform which enables small investors to invest in new start-ups online has been established.

Box 6.2. Public and Private Partnership for Agricultural Innovation: OECD countries' experience

Co-operation between various public and private actors in the agricultural innovation system is essential to increase the efficiency with which public funds are used.[1] Improving the transfer of knowledge from public research institutions is often a main motivation for the public sector to engage in PPPs in agricultural innovation systems. As private investment typically concentrates in areas where the private returns on investment are high, PPPs can be used to re-orient innovation efforts towards areas with public good aspects, long time horizons and more risks. In addition, PPPs for innovation help secure contributions that are more adapted to both public and private needs. Longer-term benefits include their contribution to fostering links and understanding between public and private researchers and between the research and business-farm community, which facilitates future co-operation and networks. Another longer-term benefit is the improvement of inter-ministerial or federal-provincial co-ordination on innovation issues, and thus of policy coherence.

Innovation actors are increasingly using PPPs to enhance vertical co-ordination in the value chain. The emphasis in this case is less on the joint creation of new knowledge than on the efficient dissemination of existing knowledge to firms which can utilise such knowledge to integrate into global value chains and compete on world markets. In the agri-food sector, non-public partners range from input suppliers and farmers to processors, retailers, NGOs and consumer representatives. Increasingly, PPPs are also considered a strategic tool to foster structural change and competitiveness.

Some OECD countries specifically facilitate the development of PPPs. Direct incentives to PPPs include funding mechanisms – for example public funding conditional on private co-financing. Similarly, other sources of funding, such as producer levies or donations, may include provisions to encourage partnerships. IP protection encourages private investment in innovation, including through PPPs. The handling of intellectual property rights (IPRs) from public research can also provide incentives to partnerships with the private sector. Improving information, knowledge flows and networking also facilitates the development of PPPs as a means to identify opportunities and partners.

In the Netherlands, the R&D strategy introduced in 2011 – the Top Sector policy – places PPPs at the heart of innovation for economic competitiveness (OECD, 2015a). This strategy makes the granting of public funding within leading sectors conditional on participation in PPPs within top sectors and gives industry a leading role in setting the innovation agendas. Public funds have to be matched with an equivalent contribution from the private sector (50-50), which can be in kind (access to facilities) or financial, in which case it can benefit from public support (investment or tax rebates). Public co-funding focusing on pre-competitive research was expected to reinforce the contribution of the private sector in this area.

In Australia, the Rural Research and Development Corporations (RDCs) are the most significant mechanism to foster PPPs for investment in rural R&D. 15 RDCs cover virtually all agricultural industries, as well as fisheries and forestry. They procure rural R&D using funds collected from primary producers via statutory or voluntary levies, together with matched funding from the Australian Government. Australia's Co-operative Research Centres (CRC) programme is another mechanism to support medium- and long-term end-user-driven research collaboration between the public and private sector. The CRCs are partnerships between different research funders, suppliers and end-users, formed to undertake R&D in specific areas, with a particular emphasis on applied R&D. CRCs receive public funding, which must be matched by participants' cash and in-kind contributions, for a period of up to ten years via a competitive merit-based selection process (OECD, 2015b).

Note: 1. PPPs for innovation are defined as "any formal relationship or arrangement over fixed-term/indefinite period of time, between public and private actors, where both sides interact in the decision-making process, and co-invest scarce resources such as money, personnel, facility, and information in order to achieve specific objectives in the area of science, technology, and innovation" (OECD, 2004).

Source: Moreddu (2016).

6.5. Facilitating knowledge flows

Because of the fragmented structure of agricultural production comprised of relatively small firms producing multiple homogeneous products, few farms are willing to investment in private R&D activities. Furthermore, because of the biological nature of agriculture, improved crop seed and animal breeds are self-replicating. This complicates the ability of innovators to protect intellectual property. In addition, many agricultural technologies tend to be geographically specific, meaning that they do not transfer directly to other locations with different soil types, weather patterns, or topography. These features imply that unique policies to foster innovation in agriculture are required (OECD, 2016a).

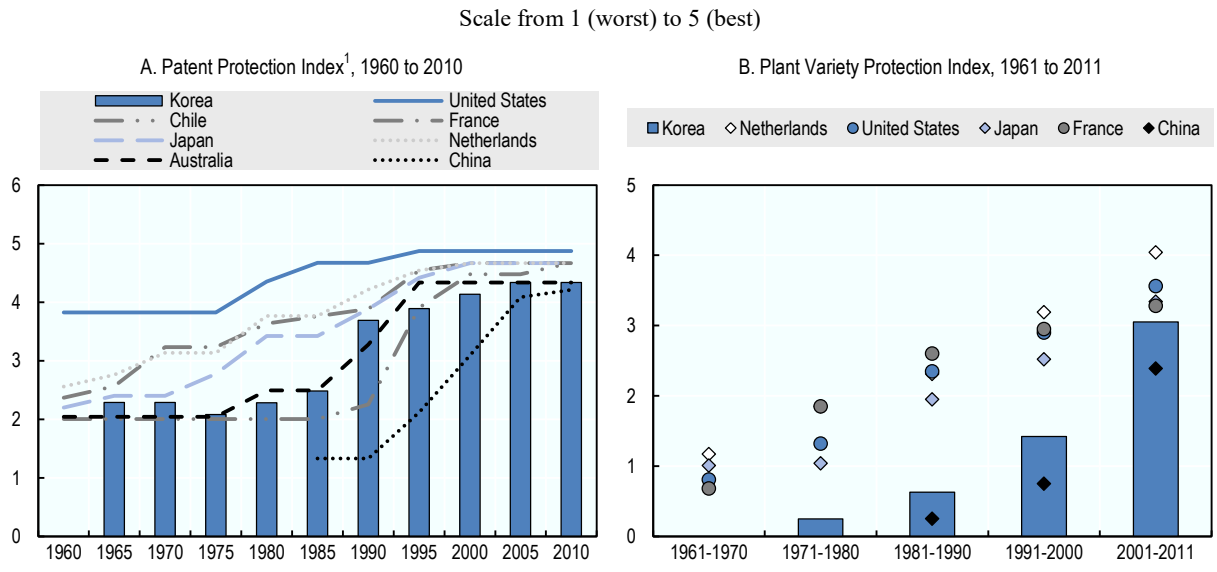
Intellectual property rights protection

Private firms would not have an incentive to invest in agriculture R&D unless they can recover the costs of private R&D. To foster private R&D, the government should allow private firms to maintain exclusive control over their discoveries by protecting intellectual property rights (IPR). Recognizing that intellectual property plays a fundamental role in creating private incentives to innovate, the government has continuously revised the laws and regulations to cope with changes in the domestic and international environment, such as amending the patent law to relax the patent application format requirements and revising the design protection law to introduce the domestic design application system.

Patent protection has been strengthened, particularly in the late 1980s, to a level comparable with many OECD countries (Figure 6.10.A). Similarly, a Plant Variety

Protection index calculated by Campi and Nuvolari (2013) shows a remarkable improvement in Korea during the 1990s and 2000s (Figure 6.11.B). Korea established a strong foundation for the private sector to invest in agricultural R&D. However, both indices show the intellectual property protection is still weaker than leading countries such as the United States and the Netherlands.

Figure 6.10. Intellectual property protection indicators



Note: 1. Overall index is the sum of indices for duration, enforcement, loss of rights, membership and coverage.
Source: Unpublished update by the OECD Secretariat of the series from Park, W.G. (2008), "International Patent Protection: 1960-2005", Research Policy, No. 37. (panel A); Campi and Nuvolari (2013), IP Protection in Plant Varieties: A New Worldwide Index (1961-2011), http://hdl.handle.net/10419/89567 (panel B).

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In 2013, the National Patent Competitiveness Improvement Plan was established to enhance the quality of IPR, including shortening the period for processing one. The government supports SMEs in coping with IPR disputes. It also promotes global intellectual property co-operation and has established both an intellectual property valuation system and financial support for expanding the use of intellectual property. The Design Protection Act was amended to introduce an international design application system. In 2013, the Industrial Property Protection and International Co-operation Bureau was established in Korea's Intellectual Property Office to enhance policy co-operation within government departments on IPR and to strengthen the enforcement of IPR protection and enterprise's ability to cope with the IPR-related disputes (Huh, 2016).

Since 2002, Korea has become a member of the International Union for the Protection of New Varieties of Food, and since 2012 it has been obliged to protect all new varieties of plants. In addition to general systems to protect IPRs, the plant variety protection system has been strengthened to facilitate the use of important varieties in farming. The new system legitimately guarantees the rights of those who grow new plant varieties in the form of IPRs, providing them with an exclusive commercial right which is similar to patent rights, copyright and trademark registration. The system aimed to protect the rights of cultivators growing new plant varieties, thereby accelerating the cultivation and dissemination of high-quality varieties. The law extended the target of the new variety protection to all plants and

differentiated the payment amount according to the delayed period of the breeder protection fee. The penalties for infringement of breed protection rights were also raised.

In Korea, technology transfer from public R&D institutions to agricultural corporation or farms is not active, leading to little follow-up of R&D performance at the farm level. The indicator of technology commercialisation (e.g. share of patents that have earned royalty income or contributed to productivity improvements) has not grown enough despite the establishment of government policies fostering ventures and start-ups and other continued efforts to promote application-developed technologies to actual production processes (Box 6.3).

Box 6.3. Support to the commercialisation of agricultural technology in Korea

To support farmers and agricultural companies to acquire IPRs for the technologies they develop, the government established the Foundation of Agricultural Technology Commercialization and Transfer (FACT) in 2009. The number of successfully established IPRs increased from 81 in 2012 to 102 in 2013. The success rate of commercialisation has also increased, from 16% in 2010 to 37% in 2016. FACT provides services on R&D planning, technology evaluation, and training and support for technology transfer through consultation with patent experts. For example, the evaluation of technologies owned by venture enterprises is used for investment matching or for attracting private capital. It also enables technology owners to get a loan from financial institutions (IP-backed loan, IP guarantee loan). The government provides financial support to these activities though its technology commercialisation assistance project and IP-backed loan programme.

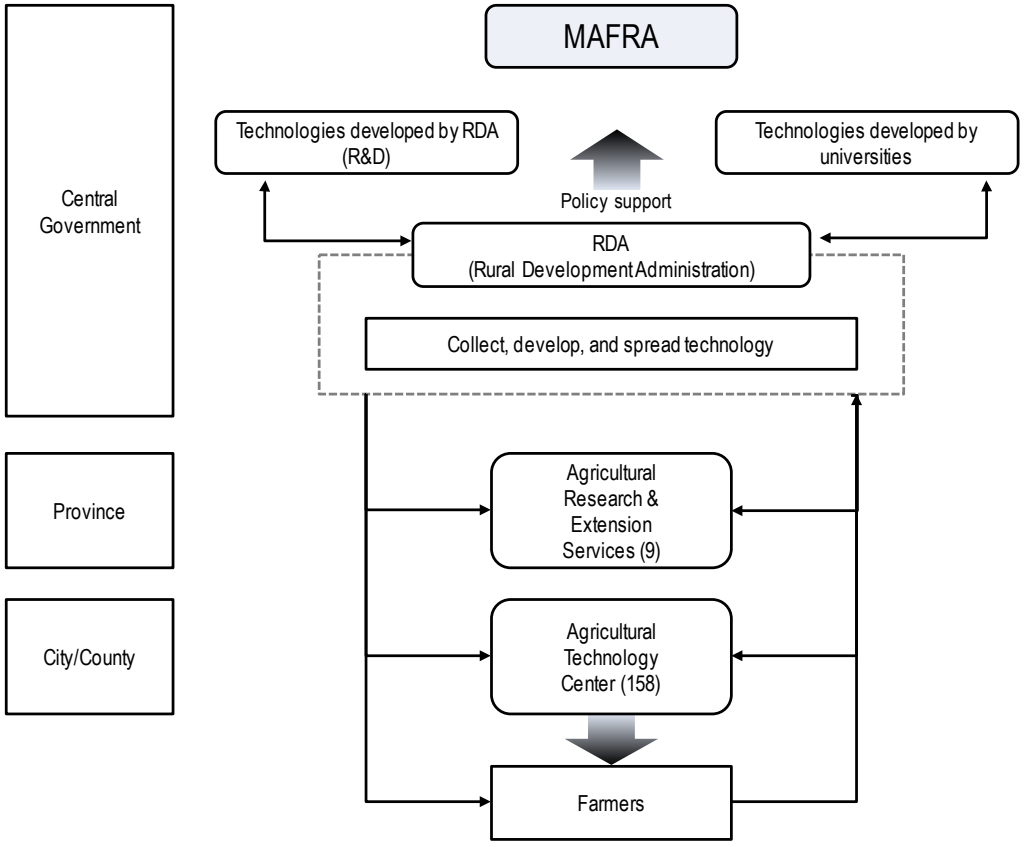
The government also designated FACT as the technology trust management institution for the agri-food sector in 2013. Universities, public research institutions and non-profit organisations entrust their unused patents to FACT, which facilitates technology transfer to its potential users. FACT carries out marketing activities for IPRs with high commercialisation potential by holding technology transfer presentation events, publishing technical description booklets and providing a technology information web service. In 2013, a total of 456 transfer contracts were concluded on state-owned patented agri-food technologies. Furthermore, the government expanded the exclusive use of state-owned agri-food patents, encouraging agri-business corporations to commercialise the state-owned IPRs. The exclusive right of use allows the designated company to have a sole right to utilise the technology.

Promoting the adoption of technologies

Public extension service

The agricultural extension system belonged to a national organisation under RDA until 1997, when the status of extension officers was shifted from national to local government officials in order to promote co-operation between the central and local governments in implementing extension services (Oh et al., 2000). Currently, local governments are responsible for developing and implementing extension projects that meet their local needs. Agricultural Technology Centres at the municipality level provide most of the farmers' education programmes and extension services. RDA currently plays a co-ordination role. For example, RDA disseminates agricultural technologies developed by a local government to other parts of the country, obtaining a permission to use the technology from the relevant local government (Figure 6.11).

Figure 6.11. Implementation System of Agricultural Extension Services in Korea

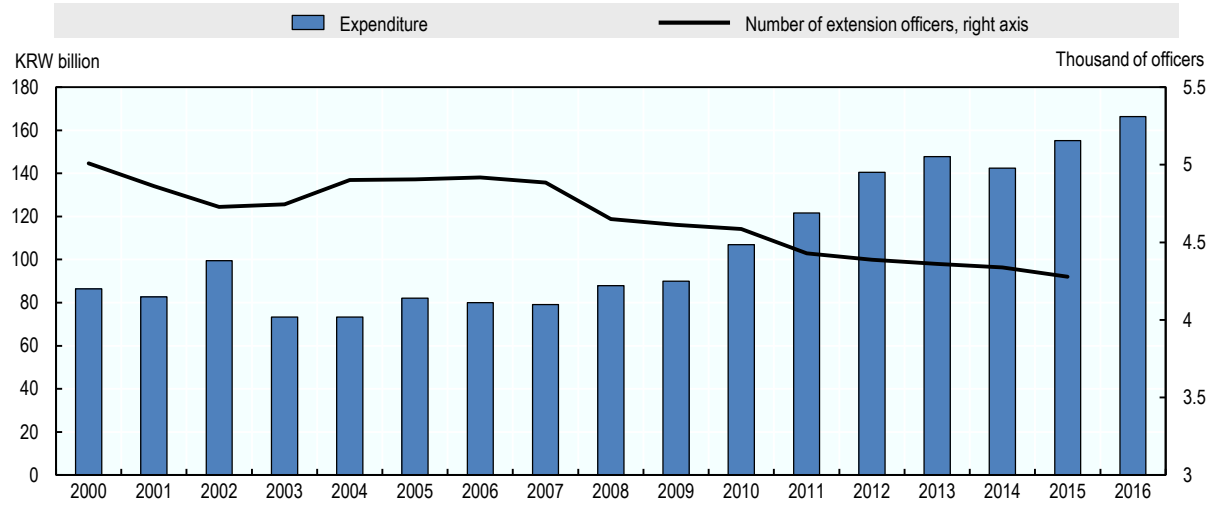


Source: RDA (2014), Basic Plan for Projects for Guidance to Agricultural Communities (2013-2017).

RDA establishes the Basic Plan for Agricultural Extension Services every five years as well as its annual implementation plan. The current Basic Plan (2013-17) aims to: 1) increase agricultural competitiveness through swift distribution of developed technologies; 2) promote the 6th Industrialisation and improve farming business management to boost rural economy; and 3) minimise damage by agricultural disasters. Expenditure for the public extension service at the central government doubled in 2000-16, keeping up with the increase in the expenditure for public R&D (Figure 6.12). The extension service currently accounts for 12% of the R&D budget, but RDA is planning to increase the ratio to 30% to promote the adoption of technology. Despite an increase in budget expenditure, the number of extension officers has been decreasing since the 1990s, when their status was shifted from being national government officers to local ones.

The government also provides various training courses for farmers. For example, the Agricultural Meister College is a two-year certificate course to foster highly qualified farmers with the latest high technologies and management skills. This certificate programme was founded in 2009 and nine Agricultural Meister Colleges were operating in 39 university campuses in 2015. Work Place Learning is a field-oriented farmer training programme to support the improvement of productivity and the quality of agricultural products. Farmers as well as students take part in training programmes and develop agricultural and managerial skills through field-oriented tasks.

Figure 6.12. Expenditure and staff in the public extension service in Korea, 2000 to 2016



Source: RDA, Rural Extension Service Report.

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Private technical advisory service

Public extension plays a major role in extending agricultural technologies to small-scale family farms, which often cannot afford the paid services. However, commercialised farmers tend to have demand for more specialised and diverse services than the standard public extension service offers. In Korea, diverse entities such as private enterprises, product organisations, agricultural co-operatives, and professional farmers offer private technical advisory services mainly to commercial family farmers and agricultural corporations.

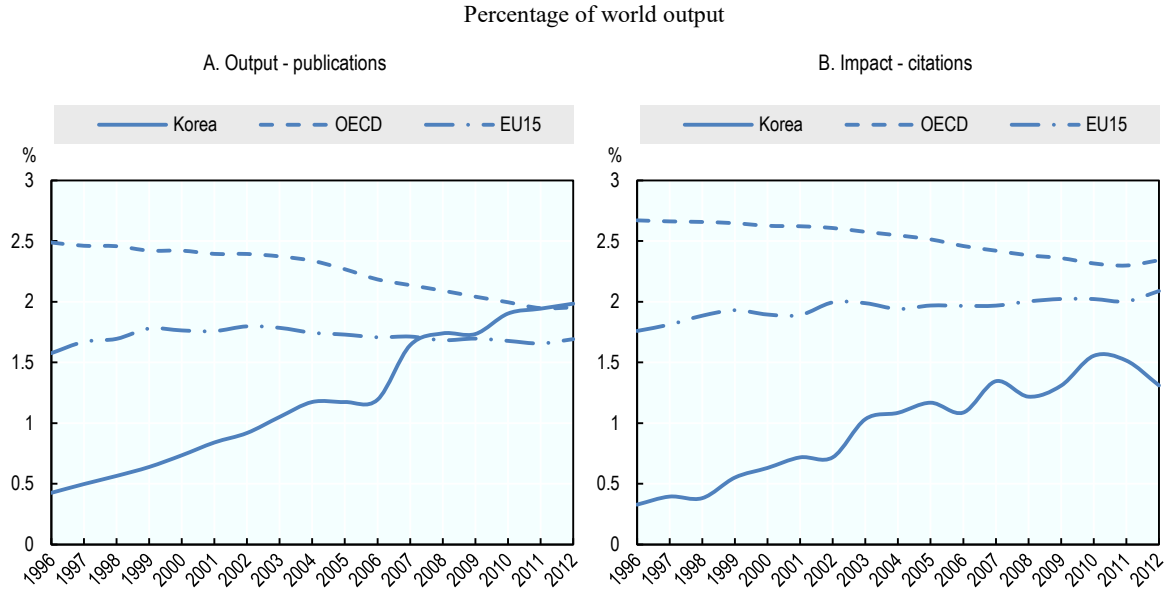
In addition to providing a fully public extension service, the government supports agricultural corporations in obtaining private consulting services to meet their specialised needs; it covers half of the expenses for professional management and technical consulting services for up to three years. The project is targeted to next-generation agricultural or fisheries enterprises, urban-to-rural returners and corporations. The average annual spending on this project declined from KRW 7.123 billion (USD 6.4 million) to KRW 3.84 billion (USD 3.3 million) in 2011-16 as the demand for consulting services is on the decrease. In Korea, a non-commercial consulting service provided by the government agencies such RDA and the Korea Agro-Fisheries & Food Trade Corp may be impeding the development of the private technical advisory service.

6.6. R&D output and impact

With increased investment in the public agriculture R&D system, scientific output in agriculture also increased rapidly over the last two decades. Output of agricultural science publications from Korean authors as a percentage of world output increased from 0.4% in 1996 to 2.0% in 2012, which is equivalent to the OECD average and above that of EU15 countries (Table 6.4; Figure 6.13). Similarly, the world share of agricultural patents exceeded both the OECD and EU15 averages. The strengthened performance evaluation of R&D by the Act on the Performance Evaluation and Management of National Research

and Development Projects in 2005 may have contributed to the increase in scientific output in Korea. However, the world share of citations is lower than the OECD and EU15 averages, indicating that the scientific impact has not increased with the number of publications. Among the three public agricultural R&D institutions (RDA, MAFRA and KFS), RDA accounted for approximately 60% of publications and registered patents.

Figure 6.13. Evolution of scientific output and impact in agricultural and food sciences, 1996 to 2012



Source: SCImago. (2014), SJR — SCImago Journal & Country Rank, http://www.scimagojr.com (accessed 13 March 2014).

StatLink https://doi.org/10.1787/888933852084

Table 6.4. Korea's agriculture and food R&D outcomes in international comparison, 2007-12

	Korea	Japan	China	United States	Netherlands	BRIICS average	OECD average	EU15 average
				Percentage				
Agro-food specialisation: Agro-food science outputs as a share of country's total (%)								
Patents	**4.3**	3.5	2.8	6.8	8.8	3.8	5.6	6.6
Publications	**6.1**	6.8	5.1	6.7	6.9	12.3	9.4	8.1
Citations	**5.8**	6.9	6.8	6.3	6.4	12.0	11.9	10.8
Country's contribution to world agro-food science output (%)								
Patents	**1.2**	3.7	1.0	10.8	1.0	0.3	0.7	0.6
Publications	**1.8**	4.3	8.3	18.3	1.6	3.1	2.0	1.8
Citations	**1.4**	4.2	6.7	27.2	2.8	1.8	2.4	2.4

Source: SCImago. (2014). SJR — SCImago Journal & Country Rank. Retrieved March 13, 2014, from http://www.scimagojr.com.

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6.7. International co-operation

The benefits of international co-operation for national innovation systems stem from the specialisation it allows and from international spill-overs. International co-operation in agricultural R&D is particularly important where global challenges (as in the case of responding to climate change) or trans-boundary issues (related to water use or pest and disease control) are encountered, and when initial investments are exceptionally high.

Korea's share of output of agricultural R&D with foreign collaborators shows that the degree of international co-operation in agricultural science is significantly less than the OECD average (Table 6.5). For example, 5.8% of Korean patents in the agri-food sector have a foreign co-inventor, which is much less than the OECD average. The percentage of agri-food publications with foreign authors is also far less than the OECD average.

Table 6.5. Agri-food R&D co-operation, 2006-11

Agri-food R&D outputs with foreign co-authors as a share of country's total agri-food outputs (%)

	Korea	Japan	China	United States	Netherlands	BRIICS average	OECD average	EU15 average
Agricultural science collaboration								
Patents	**5.8**	5.2	21.8	14.3	27.1	23.7	11.8	36.2
Publications	**31.4**	31.5	23.6	36.4	65.1	38.9	50.8	57.7

Source: OECD (2014b), http://www.scimagojr.com.

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International co-operation projects in exchanging and disseminating science and technology in the agri-food sector exist with international organisations, international research institutes, and foreign states. The government promotes joint research projects with domestic and overseas institutions to introduce foreign technologies and address global issues. For example, in 2017, RDA and the Asian Food and Agriculture Co-operation Initiative (AFACI) jointly conducted research projects on the management of migratory disease and pests, and on technologies for organic farming.

The government is also expanding its partner country and global network. RDA seeks new agendas for collaboration and reinforces its network with countries and international institutions that have advanced technologies and useful resources. For example, co-operation projects for common agricultural issues are conducted with continental technological co-operation bodies, such as AFACI, Korea-Africa Food and Agriculture Co-operation Initiative, and Korea-Latin America Food and Agriculture Co-operation Initiative. Moreover, bilateral joint research projects are conducted through the Korea-Japan Agricultural, Forestry and Fishery Technical Co-operation Committee. As of 2017, a joint research project is ongoing between RDA, Korea Food Research Institute and National Institute of Fisheries Science, and Japan's agricultural research institution under the Ministry of Agriculture, Forestry and Fisheries. The two countries share scientific and technological trends in the sector, hold a joint symposia for scientists, and carry out a researcher-exchange programme.

RDA is a primary supporter of international co-operation in the agri-food sector. It undertakes co-operative research with international organisations including members of the Consultative Group on International Agricultural Research. RDA also develops bilateral co-operation with the United States' Agricultural Research Service, the Chinese Academy

of Agricultural Sciences, the Netherlands' Wageningen University and Research, the Brazilian Agricultural Research Corporation, Japan's National Agriculture and Food Research Organization, Israel's Agricultural Research Organization, New Zealand's Plants and Food Research, Australia's Commonwealth Scientific and Industrial Research Organisation, and France's National Institute for Agricultural Research.

RDA also implements a Korea Project on International Agricultural (KOPIA) which provides technical assistance to developing countries. KOPIA operates pilot villages in developing countries to increase agricultural productivity and income based on technologies it has developed (e.g. pilot villages for high-quality rice seed production in the Philippines). KOPIA also distributes Korea's advanced farming techniques through the KOPIA centres.

6.8. Summary

As a result of increasing public investment in agricultural R&D, the intensity of public agriculture R&D expenditure in Korea has become one of the largest among OECD countries. The scientific output from the R&D system such as the world share of publications in agriculture and food exceeded both OECD and EU15 averages. The sector can benefit more from the high level of R&D investment to improve its productivity and sustainability.

Despite a series of reforms, Korea's current agricultural innovation system (AIS) is characterised by the dominance of public actors such as public research institutions and a public extension service, and the limited role of private research and technical advisory services. However, agricultural innovation today is increasingly taking place in a network-based setting, in which a more inclusive, interactive, and participatory approach fosters greater innovation in response to emerging and pressing challenges facing food and agriculture systems. A network analysis among AIS actors in Korea shows a weak connection between the private sector, producers and government. AIS in Korea should evolve to a more collaborative and demand-driven system between public and private sectors, including higher education institutions.

The complex public agricultural R&D system in Korea involving RDA, MAFRA and KFS is making co-ordination and collaboration between different public institutions involved in agricultural R&D at multiple administrative levels more difficult, despite the establishment of STCA as a co-ordinating institution. The co-ordinating function of STCA should be further strengthened to form a more consolidated and coherent public agricultural R&D investment strategy.

Korea increased efforts to enhance the participation of private enterprise in public R&D projects through a matching fund system and voucher system. However, the high level of public R&D investment could reduce incentives for private R&D investment. Public agricultural R&D investment should shift its focus to pre-competitive areas or areas of public interest which are complementary to private R&D. Moreover, the tax incentive for private R&D in agriculture is much less than in other sectors, as most farmers and agricultural corporations are exempted from income tax.

Another shortcoming of the top-down R&D system is that its output is not necessarily adopted at the farm level and does not necessarily address the practical needs of producers and food industries. Experience in OECD countries shows that enhancing the partnership between various public and private actors would increase the efficiency of public R&D

investment and help secure contributions that are better adapted to both public and private needs

As the farm population becomes more diverse and produces high value-added niche products, the standardised service of the public extension system has a limited capacity to meet producers' needs. While the government encourages the use of the private technical service through subsidies, its development is still limited. Extension services in some OECD countries have evolved to a more competitive system that is demand-driven, more pluralistic and decentralised, and that mixes both public and private providers. The public extension service should be reduced to focus on public interests such as animal disease prevention and environmental protection, allowing more diverse private companies to provide services.

Note

[1] Although established under MAFRA, RDA and KFS are operated independently from it in terms of budget and personnel affairs. KFS manages R&D projects in forestry, which are implemented by the Korea Forest Research Institute. The Korea Forestry Promotion Institute promotes commercialisation of R&D outcomes. The Animal and Plant Quarantine Agency (APQA) under MAFRA also implements R&D projects specifically on animal and plant diseases.

References

ASTI (2017), "Agricultural Science and Technology Indicators (2017)", www.asti.cgiar.org/data (last accessed in October 2017).

Campi, M. and A. Nuvolari (2013), Intellectual property protection in plan varieties: A new worldwide index (1961-2011), *LEM Working Paper Series*, No 2013/09, http://hdl.handle.net/10419/89567.

Cho, H. et al. (2003), "Analysis of the system and structure of the Korean government R&D programs and policy recommendations", Science and Technology Policy Institute.

Huh, W. (2016), "Development Plan of Intellectual Property Industry: Focusing on Improvement of IPR System", KERI Brief, Korea Economic Research Institute.

Kim, S. et al. (2015), "A study on the establishment of the 2nd Comprehensive Plan for Agri-food Science & Technology Development", Korea Rural Economic Institute, Korea Institute of Planning & Evaluation for Technology in Food, Agriculture, Forestry and Fisheries.

KREI (2015), *Agriculture in Korea 2015*, Naju, Korea.

Lee, M. et al. (2016), "Measures to Improve Agricultural R&D Governance Efficiency and Expand Private Investment (Year 2 of 2)", Korea Rural Economic Institute.

MAFRA (2016), "2nd Comprehensive Plan for Agri-food Science & Technology Development."

MSIT (2017), "Guidance on National R&D Information", *R&D Kiosk*, Vol. 35, April 2017.

Moreddu, C. (2016), "Public-Private Partnerships for Agricultural Innovation: Lessons from Recent Experiences", *OECD Food, Agriculture and Fisheries Papers*, No. 92, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jm55j9p9rmx-en.

NTIS (2017), *National Science & Technology Information Service Database*, http://rndgate.ntis.go.kr.

OECD (2017a), "Korea", in *OECD Science, Technology and Innovation Outlook 2016*, OECD Publishing, Paris, http://dx.doi.org/10.1787/sti_in_outlook-2016-58-en.

OECD (2017b), *OECD Research and Development Statistics*, Government budget appropriations or outlays.

OECD (2017c), *System of National Accounts*, https://stats.oecd.org.

OECD (2016a), *Innovation, Agricultural Productivity and Sustainability in the United States*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264264120-en.

OECD (2016b), *OECD Research and Development Statistics*, Gross domestic expenditure on R-D by sector of performance and field of science, http://stats.oecd.org/Index.aspx?DataSetCode=GERD_SCIENCE.

OECD (2016c), *System of National Accounts*, https://stats.oecd.org.

OECD (2015a), *Innovation, Agricultural Productivity and Sustainability in the Netherlands*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264238473-en.

OECD (2015b), *Innovation, Agricultural Productivity and Sustainability in Australia*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264238367-en.

OECD (2014a), *Industry and Technology Policies in Korea*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264213227-en.

OECD (2014b), *OECD Patent Database*, January 2014.

OECD (2004), "Public/Private Partnerships for Innovations", in *OECD Science, Technology and Industry Outlook 2004*, OECD Publishing, Paris, http://dx.doi.org/10.1787/sti_outlook-2004-5-en.

Oh, S. et al. (2000), "A Study on the Agricultural Extension Service System and Impact Assessment in Korea", Korea Rural Economic Institute.

RDA (2000-2016), "Rural Extension Service Report".

RDA (2014), Basic Plan for Projects for Guidance to Agricultural Communities (2013-2017).

SCImago (2014), "SJR - SCImago Journal and Country Rank", retrieved 19 March 2014 from http://www.scimagojr.com.

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Innovation, Agricultural Productivity and Sustainability in Korea

Agriculture in Korea is under increasing pressure to meet changing domestic demand, improve its productivity to keep up with the country's competitive manufacturing sector, and become more competitive at the international level. To date, the government has offered extensive support to farm income via price support, direct payments, preferential tax treatment, and reduced input prices. However, a more comprehensive policy approach is required to address the low-income problem in agriculture, and a more comprehensive rural development policy is also required to create employment opportunities for the younger generation.

Korea should explore its potential to export niche agricultural products and processed food that reflect its rich and unique food culture. To unleash the sector's potential, agricultural policy should focus on improving the productivity and sustainability of commercial enterprises and develop the food processing sector. The country's agricultural innovation system should become more integrated and collaborative, benefiting from its strong competitive advantage in Information and Communication Technology (ICT).

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