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## Korea - Republic of

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### 2012 KREI Agricultural Outlook Forum

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Agricultural Situation

**Approved By:**

M. Kathryn Ting

**Prepared By:**

FAS Seoul

**Report Highlights:**

The Korea Rural Economic Institute (KREI) held the 2012 Agricultural Outlook Forum on February 2, 2012, in Seoul. The conference covered production and marketing trends in the Korean rice, livestock, fruit and vegetable, and food processing and manufacturing sectors. The forum also included presentations on the impact of free trade agreements on the Korean agricultural sector, as well as on ongoing efforts to boost the vitality of the Korean agricultural sector. Sessions also covered organic, environmentally-friendly and local food trends; school lunch programs and impacts of climate change on agriculture.

**General Information:**

The Korea Rural Economic Institute (KREI) held the 2012 Agricultural Outlook Forum on February 2, 2012, in Seoul. The forum covered a total of 33 topics, ranging from free trade agreements (FTA) to climate change. The following is a summary of the sessions attended by Embassy staff.

**2012 Agriculture, Farming and Food Industry Outlook**

**World Major Countries' Economic Situation:** The world economy in 2012 will be heavily affected by the direction of the European financial crisis. Major developed countries will tighten their belts to ensure their own fiscal soundness and developing countries will also tighten their money to counter high prices coming from the rapid increase in liquidity. The IMF and World Bank's most recent reports forecast that the world economy may grow only 3.4% in 2012.

**Korea's Economic Situation and Outlook:** In 2011, the Korean economy grew 3.8% up from 2010. However, an even slower growth, 3.6 percent, is expected in 2012. The domestic economy will be impacted by increasing consumer price and household debts, depreciation of assets and reduced the Social Overhead Capital investment by the government. Exports may not grow due to the global economic recession and relatively strong Korean currency.

**Korean Food Industry Situation and Outlook**

**Food Manufacturing Industry:** In 2009, Korea manufactured \$57.4 billion of food, up 9.1% from \$52.6 billion in 2008. The food sector showed a 11.7% growth, while the beverage sector and tobacco sector showed a 1.9% and 0.2% decline respectively. The total value of Korea's food manufacture will slowly increase on a long-term basis.

**Impact of the Spread of FTA and our Counter agenda**

Korea has entered 8 FTAs into force with 45 nations and is currently negotiating FTAs with 12 nations. It also has a number of FTAs currently undergoing feasibility studies. In 2010, 53 percent of total agricultural imports came from countries where there is a FTA. With respect to the KORUS FTA, projections are that Korean agricultural production will drop by 678.5 billion won (US\$605.8 million) in year 5. This is projected to further go up to 991.2 billion won (US\$885 million) in year 10 and 1,235.4 billion won (US\$1,103 million) in year 15. The total accumulated production drop for 15 years after its implementation is 12,225.2 billion won (US\$10,915.4 million).

The total amount of support to be provided to farmers due to KORUS FTA is 23.4 trillion won (this is about US\$ 20.9 billion and does not include the 0.7 trillion won for fishery). Out of this, 7 trillion won will come from the 119 trillion won farm support program. Some of the support

programs include direct payment for farmers that suffer losses due to FTA, compensation for farmers that stop farming, training, modernization of livestock facilities, insurance, direct payment for stabilization of income, etc. The presenter stressed the need for enhancing the efficacy of support programs and efforts by the agricultural sector itself.

## **Overview & Outlook of the Korean Food Processing Industry**

### **Production & Added-Value**

- Total production of the Korean food processing industry is estimated at 69.4 trillion won in 2011, up 5.5 percent from the previous year. The annual growth of the industry production has been on a decline since 2008. Total value added by the industry is estimated at 24 trillion won in 2011, up 4.9 percent from the previous year. The ratio of added value over total production has declined to 34.5 percent in 2011, a significant decline from 40.9 percent in the mid 2000's.

### **Trends by Product**

- Products that led the growth between 2005 through 2011 were processed livestock meat, processed produce, processed grain, and processed fat & oil. On the other hand, processed dairy products and beverages showed less growth during the period.
- Changes in consumer preferences (such as healthy diet), alternative demand for price inflation (such as dining out), and new growth in demand (such as packaged Kimchi) were the major reasons for increased production in the industry.
- Total exports of the industry amounted to \$3 billion in 2010. Processed products have been accounting for a half of total Korean agricultural exports since 2006.
- Major export products were tobacco, processed prepared foods, table sugars, instant coffee, and instant noodles. Japan, China, and the U.S. were the major export market for Korea.
- Total exports in 2011 through November amounted to \$3.9 billion, up 25.8 percent from the previous year. Products that showed strong export growth in 2011 were beverages (bottled water and coffee drinks), instant coffee mixes, liquor (rice wine and beer), and snacks.
- Total number of food processing companies in the industry was 4,169 in 2009, up 21.5 percent from 2000. However, the number of companies that sell less than 1 billion won of annual sales accounted for 19.4 percent of the industry, a significant decline from 39.1 percent in 2000.
- Large companies are maintaining dominant market share for many products. For example, top 4 processors accounted for 76 percent of noodle production, 61 percent of

tea production, and 56 percent of cooking oil production.

- Large companies showed much higher per labor added value than small companies.
- Increased numbers of food processors are developing products in cooperation with regional farmer groups for higher brand recognition. For example, CJ has launched rice wine in partnership with rice farms in Junjoo province.
- Growth of the industry production is expected to slow down to 3 percent in 2012. Beverage segment may be the slowest growing segment (2 percent).
- Growth of single or dual member households and expansion of 'silver' population will be a force behind new industry trends.
- Foreign markets, particularly China and South Asian countries, will show bigger demand for Korean processed foods.
- Bacon, packaged Kimchi, organic processed food, processed rice products, refrigerated sauces, functional herb products, NFC fruit juices are likely to show strong production growth in the coming year.

### **Environmental Friendly Ag. Products and Processed Organic Products Situation**

The Korean government has been promoting the environmentally friendly agricultural product (EFAP – including organic and no pesticide products) industry to improve the competitiveness of local agricultural products. In 2011, EFAP accounted for 11 percent of Korea's total agricultural products in value and is expected to increase to 19 percent by 2020. To date, the promotion policy has been focused on the production side, and not consumption side. To grow the industry and expand consumption to absorb the increased production, Korea needs to think about how to attract more consumers and meet the consumer demand for EFAP. The price of organic products is 1.9 times higher than conventional products. One survey also shows that over 75 percent of consumers thought that EFAP was expensive. Reducing product cost, improving distribution channel, building up a reliable certification system, diversifying processed products, and introducing EFAP to the school meal program would help expand the EFAP market in Korea. For processed organic products, as demand increases, production of organic products in Korea would increase. As Korea is highly dependent on imported organic ingredients, imports of organic ingredients would increase accordingly. Imports of finished organic products are expected to continue to increase steadily.

### **Improved Product Supply to School Feeding Program**

- Official school feeding program started in 1997 in elementary schools, and expanded to

high schools in 1999 and to middle schools in 2003. 99.9 percent of Korean students, about 7.18 million students in 11,389 schools, are covered by the program.

- Outbreaks of food poisoning incidents in 2006 encouraged more schools to switch from commercial service to direct operation. As of 2010, 95 percent of schools are running the program directly.
- Majority of the schools are procuring food products for the feeding program on their own. 26 percent of the schools are doing a group purchase with other schools.
- For more stable and safe supply of products, group purchases are encouraged, but the schools need support and guidance from the local and central government.
- Policy makers and administrators of the school feeding program should pay attention to developing new measure that will encourage the school feeding program to use more environment-friendly and locally grown agricultural products.

## **Local Food & Regional Specialty Food Market Opportunities**

As the distribution channels for food and agricultural products diversify, there is growing consumer interest in locally produced food. Farmers and retailers also want to play important parts in this niche market but the current market share of local food is small. A growing local food market can help local communities achieve economic growth, better health & nutrition, food safety, and environmental goals.

### **Outlook Conference of Rice**

Production: According to a KREI survey conducted during December 23-27, 2011, Korean rice farmers 2012 planting intention was 847,000 HA, down 7,000 HA or 0.8 % from the previous year. This reduction is far lower than the 2.2 % annual average reduction in planted area for the past five years. Higher market prices after the 2011 rice harvest have encouraged rice farmers to continue rice cultivation in their paddy field. The completion of four river projects has also allowed more rice farmers to resume rice cultivation. Rice farmers who participated in the government rice reduction program in 2011 plan to return to rice from other crops such as soybeans and radish etc because they had experienced difficulties not only from lower income due to declining prices of these other crops but also in finding a way to sell them.

In the mid-longer term, KREI expects rice area to continue declining to 804,000 HA in 2018 and 758,000 HA in 2023.

Government rice purchase under the Public Rice Stockholding Program (PRSP) reached 261,000 MT (milled basis), or 76.8 percent of the purchasing plan for the 2011 crop, because rice farmers preferred to market their rice rather than sell to the government whose initial payment was lower than the market price during the harvest season (Oct-Dec).

## **Trend and Outlook for Fruit Supply and Demand**

Local fruit production for 2012 is forecast to decrease slightly compared to the previous years. With the implementation of the KORUS FTA and a smooth progress on the phytosanitary negotiations, imports of U.S. origin fruit are expected as follows: For apples, it may start to enter the Korean market after September 2012 with the completion of the phytosanitary negotiations. The import volume may not significant at the beginning within the maximum level of safeguard applied 9,000 metric tons. U.S. pears are forecast to be not competitive in the Korean market as the major US pear varieties are not attractive to Korean consumers. Even Asian pears produced in the United States are not quite same as Korean pears in terms of quality. Thus the impact of U.S. pear import is expected to be minimal. For oranges, the import of U.S. oranges in 2012 is expected to increase by 20,000 MT, 13 percent up from the previous season with the benefit of reduced seasonal tariff. For table grapes, a considerable increase in import like Chilean grapes is not expected due to the limit in available import volume of table grapes produced in the United States. Instead, imports of U.S. processed grape products such as wine and raisins are expected to increase. With the immediate removal of tariff, import of cherries is expected to increase noticeably. Under the aforementioned forecast on the impact of the KORUS FTA, Korea may face over supply of fruit in the domestic market in 2012.

## **Vegetables**

**Dried Capsicum for red pepper powder:** Estimated amount for supply of dried capsicum in 2011 is at 195,000 metric tons, under the production decline and import increase. Due to local production decline, price has been rapidly increased which resulted in 3% decrease of per capita consumption to 3.3kg in 2011. The total import of dried capsicum increased to 100,500 metric tons, reaching at the highest number, three times bigger than that of 2000. Most of the imported dried capsicum is imported from China. The retail price for imported Chinese dried capsicum was KRW 6,650 (about \$6) which is 55~60% of domestic capsicum. Per capita consumption of dried capsicum decreased by annual average 2% to 3.5kg in 2010 from 4.3kg in 2000.

**Garlic:** The reduction is due to the increase of production cost, expand of aging society resulting reduces of cultivating area, and decline of Kimchi consumption. Per capita consumption for 2011 is estimated at 7.7kg with increase of 3% compared to last year. China is the biggest supplier of garlic importer. Annual import amount was increased by annual average 8% to 89,000 metric tons in 2010 from 52,000 metric tons from 2003. Total imported garlic amount for 2011 is estimated at less than 80,000 metric tons, due to the price reduction of domestic products by 30% drop down.

**Onion:** The augment is due to an increase of western style dietary life and an expansion of perception regarding onions as healthy well-being food. Per capita consumption for 2011 is

estimated at 31.4kg which is increased by 21% compared to annual average (26kg), 6% compared to last year (29.7kg.) According to survey, 7% of Korean consumers are willing to purchase imported onions from China if the price is set as 75% of domestic products; moreover, 50% of price for 19% consumers; 30% of price, 8% consumers. Increasing the domestic production brought decrease of imported amount down to 49,000 metric tons in 2010. Starting from 2006, the Chinese imported onions price was kept at 90% of domestic products price or even higher.

**Green Onion:** Import of green onions is divided into three categories: fresh, frozen, and dried. Converting all the types of green onions into fresh onions brings 5 to 60,000 metric tons of total imports since 2000. Imported amount in 2011 was increased by 23% compared to last year at 73,000 metric tons. The number takes 15% of domestic supply. Import of fresh green onions hardly processed, unless excessive price increase in domestic products. Dried green onions were imported 1,848 metric tons in 2011. Frozen green onions were imported 5,100 metric tons in 2000, however, after China joining WTO, in 2002 the number has been started to increase by annual average 7% to 30,000 metric tons in 2010. In 2011, 29,700 metric tons were imported. Per capita consumption for 2011 is estimated at 9.7kg increased by 32% compared to last year, due to the price augmentation.

### **Vegetable Price Instability and Countermeasures**

The main reason for the price instability of Napa cabbages, chilies, and garlic are due to weather. For cabbage, if there is a price decline during the previous season, cabbage farmers tend to speculate that the prices will go up the following year which causes the cultivated area for the following year to expand. However, garlic and chilies producers tend to increase their planted area in the following year if the prices are high during the previous year. However, for garlic and chilies, the overall production area will continue to drop despite high prices during the previous year, due to shortage in manpower and aging of the garlic and chilies farmers. In order to stabilize vegetable prices, systematization of contract cultivation is needed among producer organizations. Moreover, storage systems need to be standardized and systematized to deal with short-term market failures.

### **Trend and Outlook for Livestock Supply and Demand** **Cattle and beef**

Due to the low calf prices and lower semen sales, cattle inventory is projected to drop in 2012. This may fall even further to 2,790,000 heads if the government program to reduce the cow inventory by 100,000 heads in 2012 is effective. High inventory and increased slaughter

number will increase beef production by 18 percent in 2012.

Beef consumption continues to increase as consumers take advantage of the domestic beef sale promotion activities. Also the percentage of consumers that had purchased U.S. beef in 2011 was 48.0 percent, over twice the 2010 level of 22.1 percent.

The projected appreciation of the won currency and the implementation of the KORUS FTA, etc., will lower the import prices for U.S. beef by 0.9 percent. However, as the import price of Australian beef is projected to go up and due to higher domestic beef production, the overall beef imports is projected to drop in 2012.

	Unit	CY 2011	Forecast		
			CY 2012	CY 2017	CY 2022
Inventory	000 heads	2,950	2,890	2,530~2,580	2,490~2,500
Production (Boneless basis)	1,000 tons	216	255	253	249
Import (Quarantine basis)	1,000 tons	289	272	309	336
Per Capita Consumption (Boneless basis)	Kilogram	10.7	11.1	12.1	12.7
Hanwoo carcass price	Won / Kg	12,782	12,069	12,739	13,612

Source: Korea Rural Economic Research Institute (KREI)

### Swine and pork

As sow numbers rapidly increased in 2011, after the FMD outbreak in late 2010, the total swine inventory is recovering. The total inventory is projected to exceed 9 million head by September 2012. However, annual average inventory is projected at 8.84 million heads. Higher swine inventory will allow for pork production to increase by 19.3 percent over the 2011 level.

As domestic pork production recovers from the FMD crisis, domestic pork prices will drop in 2012, allowing for increased consumption of domestic pork. According to a survey by KREI, 24 percent of consumers preferred chicken as an alternative for domestic pork whereas 22 percent chose fish and 17 percent chose domestic Hanwoo beef, spurred by Hanwoo beef promotions.

As more domestic pork becomes available, pork imports are projected to drop in 2012. Given that 2011 was an abnormal case where Korea had imported massive amounts of pork in 2011 to cope with the shortage in domestic pork production, it is inevitable that pork imports will drop in 2012.

	Unit	CY 2011	Forecast		
			CY 2012	CY 2017	CY 2022
Inventory	000 heads	8,171	8,840	9,750	9,990



Production (Boneless basis)	1,000 tons	575.8	687.1	771.3	800.1
Import (Quarantine basis)	1,000 tons	370.4	256.3	289.1	321.0
Per Capita Consumption (Boneless basis)	Kilogram	19.2	19.3	21.4	22.7
Hanwoo carcass price	Won / Kg	5,808	4,669	4,495	4,652

Source: Korea Rural Economic Research Institute (KREI)

### Poultry <Broiler>

Due to the increased number of parental stock (PS) throughout the 2011, the average annual inventory in 2012 is forecast at 87.2 million birds, up 3.5 percent from 2011. Therefore, broiler meat production is forecast at 473,000 tons (boneless basis) in 2012, up 3.9% from the production (455,200 tons) in 2011.

Broiler meat demand in the first half of 2012 is expected to decrease slightly due to the diminished substitute demand for pork with recovery of domestic pork production from the FMD outbreak in 2011. However, still the broiler meat consumption is expected to increase gradually along with the trend of increasing meat consumption.

With the expected increase of broiler inventory during the first half of 2012, broiler meat imports are expected to decrease by 11.9 percent at 96,000 tons. However, frozen U.S. broiler meat is forecast to increase its market share due to price competitiveness and the lower tariffs expected with implementation of KORUS FTA in 2012.

	Unit	CY 2011	Forecast		
			CY 2012	CY 2017	CY 2022
Annual Average Inventory	Million bird	84.2	87.2	93.6	96.8
Production (Boneless basis)	1,000 tons	455	473	511	530
Import (Quarantine basis)	1,000 tons	109	96	105	113
Per Capita Consumption (Boneless basis)	Kilogram	11.2	11.3	12.3	12.8
Farm Price	Won / Kg	1,857	1,729	2,037	2,283

Source: 2011 Forecast by the Korea Rural Economic Research Institute (KREI)

### Livestock Policies

The Ministry for Food, Agriculture, Forestry and Fisheries (MFAFF) provided a summary of the various livestock policies that it was planning for 2012.

**Beef cattle and beef:** MFAFF will continue to encourage discount sale of Hanwoo beef through agricultural cooperatives and also replace pork and imported beef for military use with domestic Hanwoo and Holstein. In order to promote the less popular Holstein beef, MFAFF will foster restaurants and processed beef products specializing in such meat. It will also run a trial of slaughtering 1,000 head of Holstein steer calves and try to develop a veal market. It will also budget a total of 30 billion won in 2012 to help reduce the lower quality Hanwoo cows. MFAFF hopes that it will be able to reduce up to 200,000 head of Hanwoo cows by the

end of 2013.

**Swine and Pork:** MFAFF will provide a TRQ of 70,000 MT for pork imports in 2012 (50,000 MT for pork bellies and 20,000 MT for processing). It will also provide a TRQ for 5,000 heads of sow imports.

**Dairy and chicken:** MFAFF will allocate a TRQ of 40,000 MT for 8 dairy products during the first half of 2012. As for chicken, it will try to stabilize the price by having the major packers release their stocks during the high consumption period and continue to increase exports of ginseng chicken soup.

**Improvement of livestock products' marketing structure:**

- Develop the Ahnshim livestock company owned by the National Agricultural Cooperative Federation into a packer like the Danish Crown.
- Improve the performance of the slaughter plants by reducing the current 83 slaughter houses into 36 by 2015.
- Make it mandatory to market meat products in packages by 2015 by increasing the percentage of boxed meat being auctioned in wholesale markets.
- Increase the sale of meat products through internet to reduce marketing costs.
- Increase the number of butcher shop style restaurants.

**Introduction of licensing for livestock business:** MFAFF will gradually introduce the licensing system for the livestock farmers, beginning with company-owned farms in 2013 and gradually enlarging it to small farms by 2016.

**Establish a constant quarantine system against livestock diseases:** MFAFF will introduce a system where there is constant monitoring of livestock diseases, such as FMD and AI.

**Stabilization of compound feed prices:** MFAFF will extend by one year the repayment period for loans to the livestock farmers to purchase compound feed and will also expand the acreage for producing roughage to 330,000 hectares by 2012. It will also provide TRQ for 21 feed products and extend the VAT (value added tax) exemption for compound feed up to 2014.

**Dairy industry:** MFAFF will announce a plan for developing the dairy industry in February. It will also provide support for modernization of the facilities, R&D, etc., to improve the dairy industry's competitiveness.

**Livestock Manure treatment:** MFAFF will continue to monitor and provide consulting to farmers so that they can cope with the ban that went into effect as of January 1, 2012, on disposing livestock manure in open sea.

**R&D for livestock industry:** MFAFF has established an organization called the "Future Livestock Forum" to coordinate research that is currently scattered among various research agencies.

**Fostering of the equine industry:** MIFAFF will provide support for developing the equine industry into a leisure business. It will also support the establishment of 100 farms raising horses.

**Increased export of veterinary drugs:** Korea is currently exporting about \$100 million worth of veterinary drugs to 82 countries. MIFAFF will provide support for marketing efforts in the overseas market.

### **Scenario for climate change and its use in agriculture**

Won Tae Kwon, Director General of National Center for Intensive Observation of Severe Weather (NIMR) noted that in the last 100 years, Earth's average surface temperature increased by 0.74°C and the sea level rose by 17 cm. On the other hand, Snow cover has decreased in the Northern hemisphere at 2.7% per decade. On top of that, these changes are becoming even more severe and frequent over time.

#### **Korea's Climate Change**

Over the last 90 years, Korea's average temperature rose by 1.8°C and annual average rainfall rose by 200 mm. Temperature rise is extreme in winter and spring and relatively low in summer. As a result of global warming, summer in Korea is definitely getting longer and hotter and winter is short-lived. The growth season for spring flowers has been extended and fall foliage season is cut short, causing leaves to change colors and drop faster than in the past. Likewise, seawater temperature around the Korean peninsula has risen by 1°C. Climate change will also have an effect on cultivation land for apples and garlic, habitat loss for migrating birds in Korea and changes in the marine ecosystem. The number of days when Han River is frozen no longer exceeds 20 days per year.

The representative concentration pathway (RCP) was used to make climate predictions for both the world and for Korea under two scenarios: RCP 8.5 referring to "no action", and high concentration with continuous greenhouse gas emission and RCP 4.5 referring to a stable low concentration scenario where there are some efforts to reduce greenhouse gas. Impacts for the whole world and Korea differ according to different RCPs as shown below.

#### **Future climate predictions (2070-2099)**

	<b>RCP 4.5</b>	<b>RCP 8.5</b>
<b>Temperature</b>	+ 2.8°C	+4.8°C
<b>Precipitation</b>	+4.5%	+6.0%
<b>Water elevation</b>	72.7cm	90.0cm

#### **Korea (2070-2099)**

	<b>RCP 4.5</b>	<b>RCP 8.5</b>
<b>Temperature</b>	+3.4°C	+6.0°C
<b>Precipitation</b>	+17.3%	+20.4%
<b>Heat wave</b>	+23.8 days	+57.4 days

<b>Tropical night</b>	+30.9 days	+59.1 days
<b>Below 0°C</b>	-28.4 days	-53.1 days
<b>Heavy rain</b>	+4.24 days	+4.39 days

### Natural disasters and food security

Korea's annual average property damage from natural disasters is approximately 2.3 trillion won, more than a 3-fold increase since 1980 (700 billion won). Restoration of the domestic agricultural industry cost 670.5 billion won per year over the past 10 years. Typhoon-induced repair costs accounted for 39%, heavy snow 29%, and heavy rain 28%.

The total area of farmland decreased by 16,017 hectares per year for the past 30 years and the area of rice paddies has diminished every year since it peaked at 1,357,857 hectares in 1988.

Recent global phenomenon such as global warming, severe drought and heavy rainfall have caused unstable agricultural production. Diseases and insect pest problems make it more difficult to predict crop production. The occurrence of Rice stripe virus (RSV) has been confirmed in some parts of South Korea.

Studies show the potential impact of climate change on Korean rice and barley yields:

#### Average yield per hectare of rice

		<u>Average yield per hectare of rice (kg/ha)</u>			
		1971~2000	2011~2040	2041~2070	2071~2100
Scenario 1: Temperature change, CO <sub>2</sub> stable		11,809	9,797	8,422	7,669
	Scenario 2: Temperature stable, CO <sub>2</sub> change	11,809	13,314	14,570	15,429
	Scenario 3: Temperature change, CO <sub>2</sub> change	11,809	11,044	10,395	10,020

Ideal temperature for growing rice in Korea is around 22°C. Rice is extremely vulnerable to rapidly changing temperature so the yields will decrease in scenario 1 and 3.

#### Average yield per hectare of barley

		<u>Average yield per hectare of barley(kg/ha)</u>			
		1971~2000	2011~2040	2041~2070	2071~2100
Scenario 1: Temperature change, CO <sub>2</sub> stable	Unhulled barley	6,876	6,949	6,430	5,501
	Rye	6,101	5,572	5,061	4,002
Scenario 2: Temperature stable, CO <sub>2</sub> change	Unhulled barley	6,876	7,707	8,828	9,839
	Rye	6,101	6,476	7,346	8,011
Scenario 3:	Unhulled	6,876	7,795	8,351	8,205

Temperature change, CO <sub>2</sub> change	barley				
	Rye	6,101	6,612	7,044	6,883

Barley is commonly grown in high temperatures. Barley, which is cultivated in the central area of the south, would be cultivable in the north as the weather gets warmer. Scenario 3 is the most ideal because CO<sub>2</sub> is able to stimulate photosynthesis at night.

### **Reducing climate change impacts on agriculture**

Three factors cause climate change: rise in temperature due to higher concentration of greenhouse gases, change in global-scale heat and hydrological balance, and lastly, [El Niño/la Niña](#). Climate change can have both positive and negative impacts on the agricultural sector. Firstly, climate change can help by lengthening the period of growing crops, enabling introduction of new varieties, and saving heating costs for certain crops grown in facilities. At the same time, climate change decreases volume and quality of crops due to high temperatures, makes weeds and pests flourish, and worsens soil fertility. Also, climate change can change distribution of crops that are primarily grown in certain regions, posing either crisis or opportunity.

Weather phenomena caused by global warming is making global price of crops become volatile and the problem of food security to loom large. During the global food crisis of 2008, for example, soybean prices reached 553 USD/t and wheat prices 403 USD/t. In Korea, the situation worsened in the summer with heat waves and heavy rains affecting the price fluctuation and destabilization of premium cabbages. Price of the cabbage was KRW 6,800 per 10kg in August, 2010, but doubled in price in September.

The Korean agricultural sector is responsible for 3% of total national emissions – 54.1% is used in agri-production and 45.9% in livestock. Methane (CH<sub>4</sub>) emissions from flooded rice cultivation are 57.1% of all gas emissions. Emissions are also produced through intestinal fermentation of ruminant livestock and decomposition of animal waste. 42.9% of Nitrous oxide (N<sub>2</sub>O) is emitted when trying out nitrogenous fertilizer and decomposing animal waste.

Korea ratified the United Nations Framework Convention on Climate Change in December 1993 and the Kyoto Protocol in November 2002. Auto-control greenhouse and geothermal heat pump installation is now booming in Korea. Furthermore, transformation of livestock manure into resources has accomplished energy reduction and expansion of renewable energy.

The two main objectives to counter climate change are: Green House Gas (GHG) reduction by 35% of total projected emissions in 2020 and agricultural adaptation to climatic variation through Farming Future initiative. The government is to provide modern agricultural subsidy programs, develop alternative technology suitable for local specialties, and improve seeding methods.

