The Pacific Food System Outlook 2008-09, Annual Meeting, September 15-17, 2008

Impact and Countermeasures of Climate Change
- Korea Perspective -

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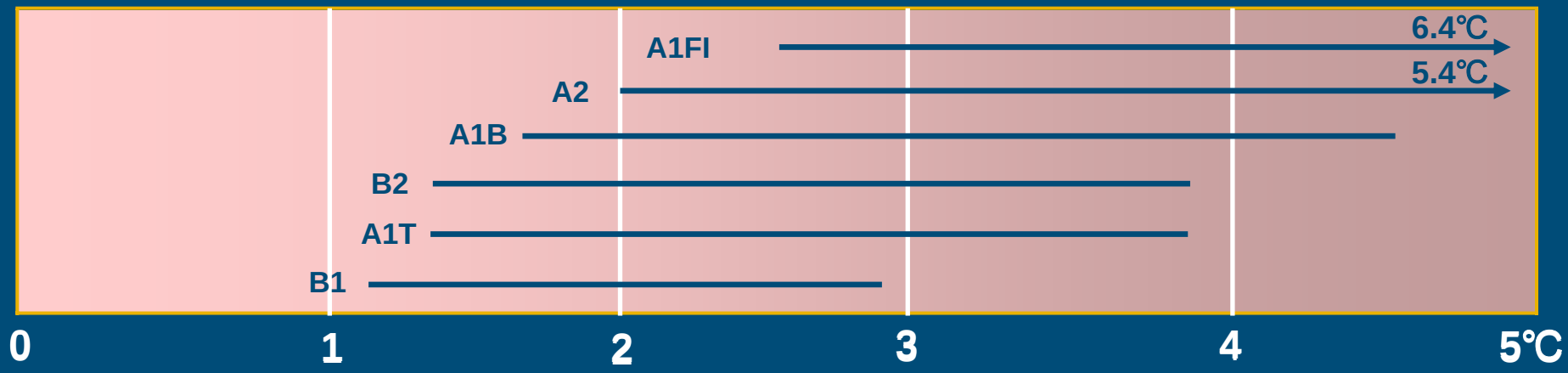
Introduction

IPCC Report (2007) – Temperature and Agriculture

<Warming by 2090-2099 relative to 1980-1999 for non-mitigation scenarios>



Complex, localised negative impacts on small holders, subsistence farmers and fishers

Tendencies for cereal productivity to decrease in low latitudes

Productivity of all cereals decreases in low latitudes

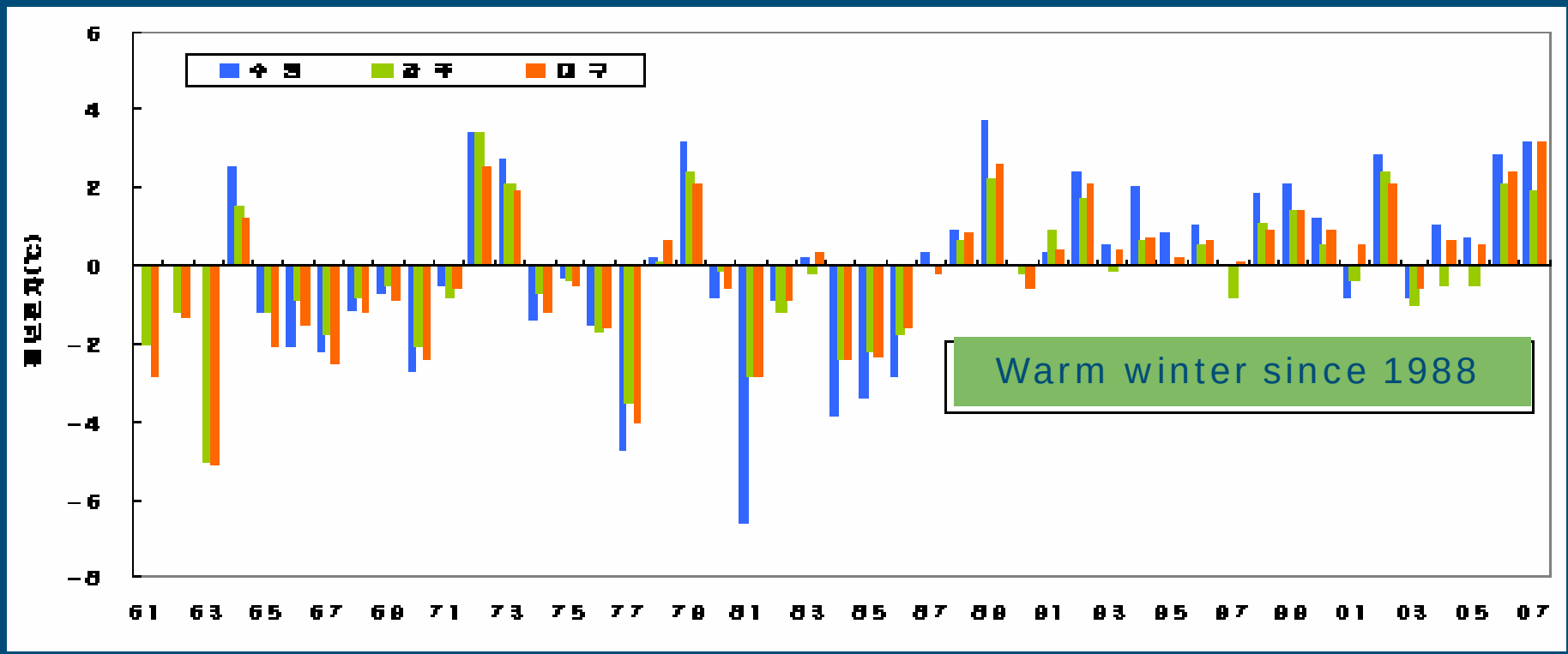
Tendencies for some cereal productivity to increase at mid- to high latitudes

Cereal productivity to decrease in some regions

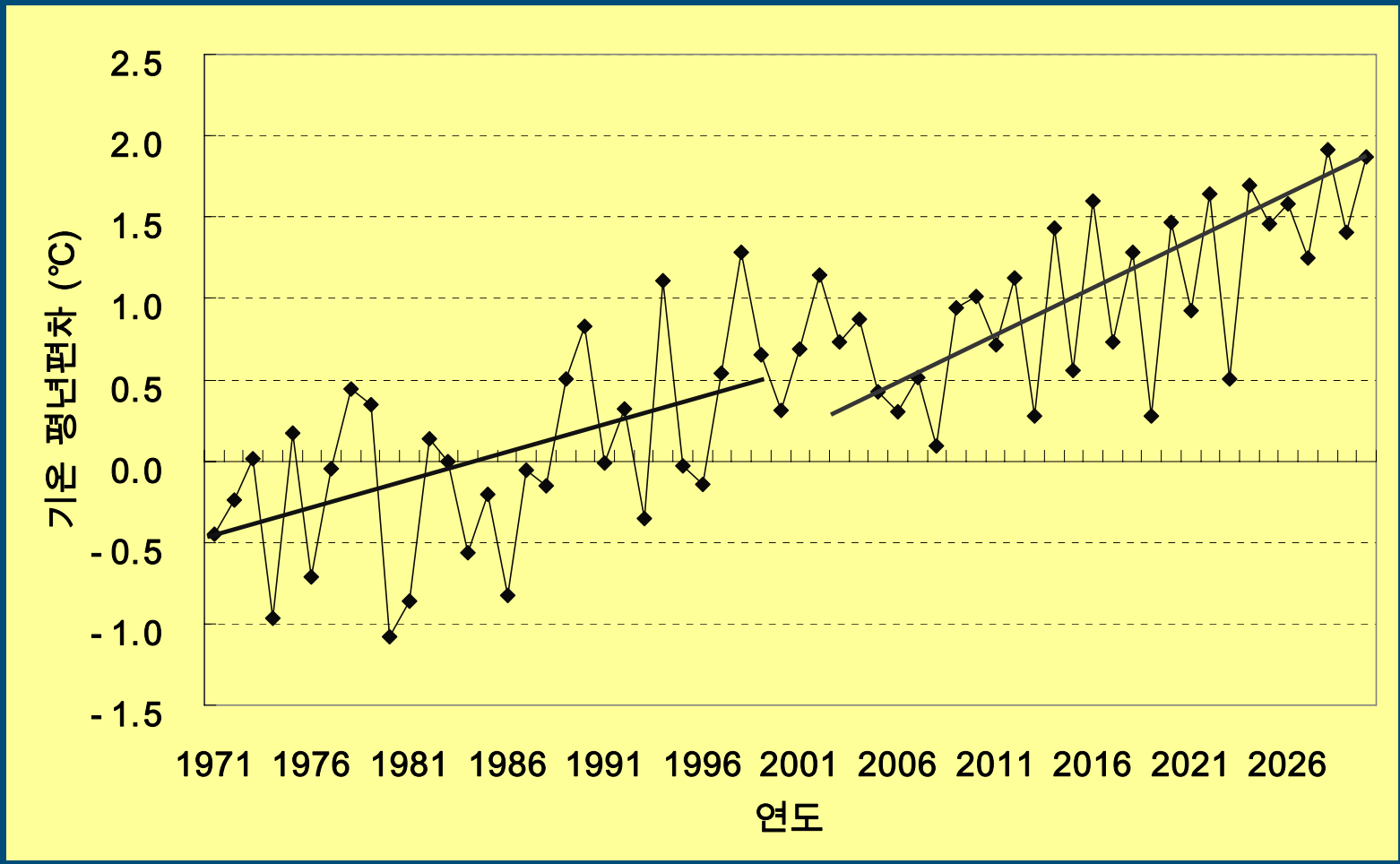
<Impacts Associated with Global Average Temperature Change>

❑ Temperature rise & warm winter in Korea

- Temperature rise : Global level 0.74℃, Korea 1.5℃/100 yr
- Seasonal Temp. Rise : Winter 1.9℃, Summer 0.3℃/30 yr

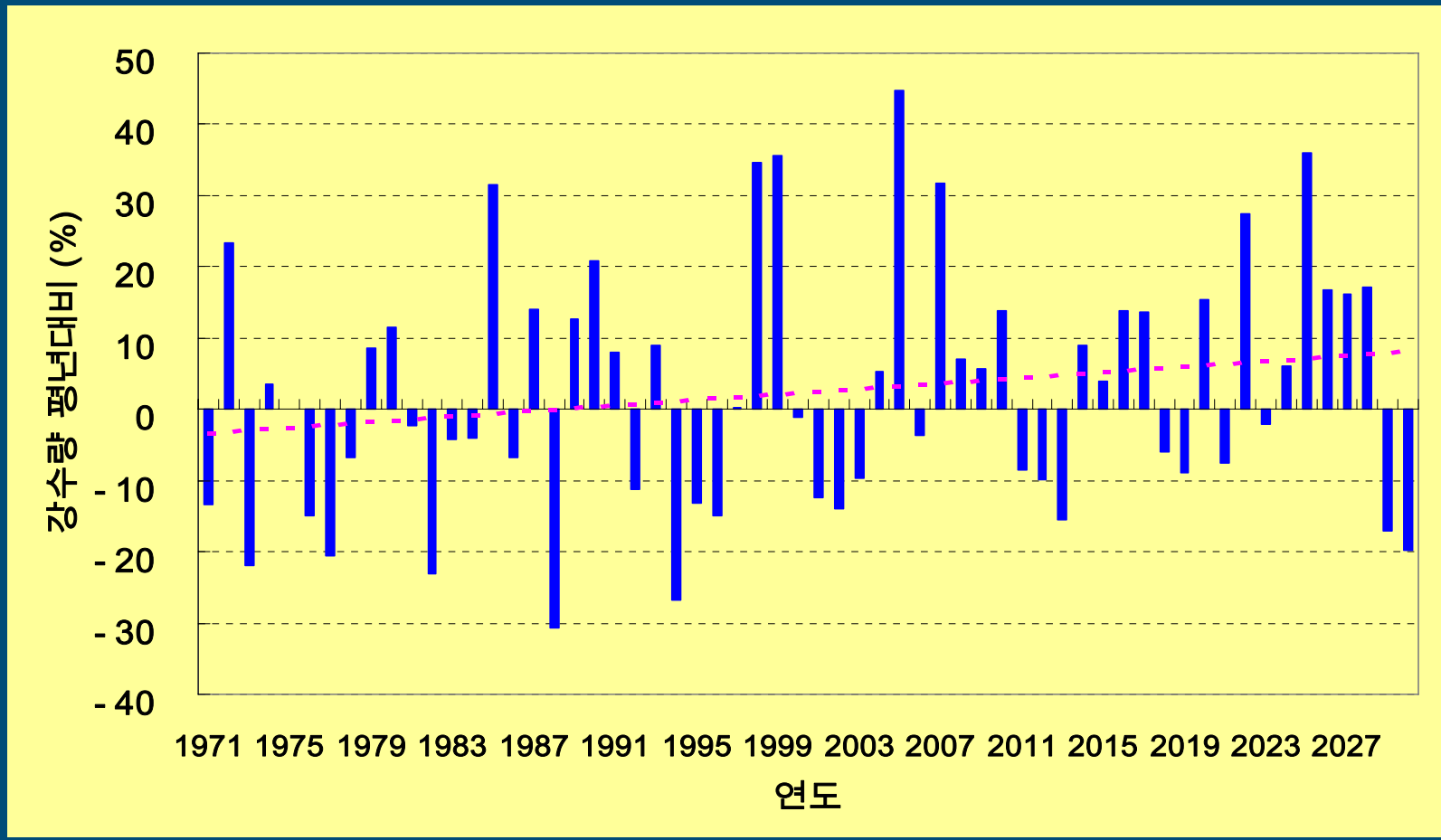


Temperature Projection (1971-2030)



▸ Increase 1.04℃(1971-2000), 1.79℃ (2001-2030)

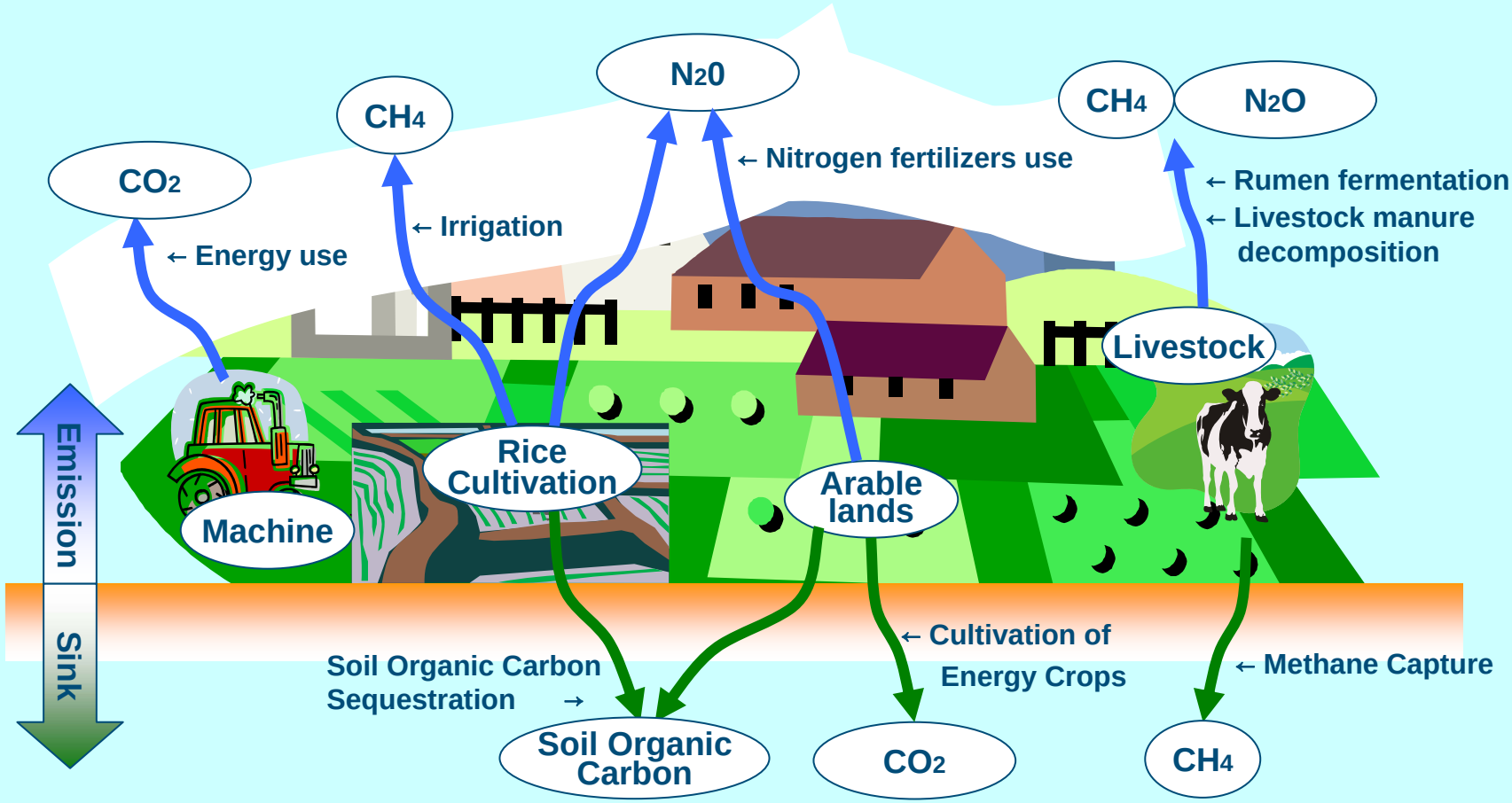
Precipitation Projection (1971-2030)



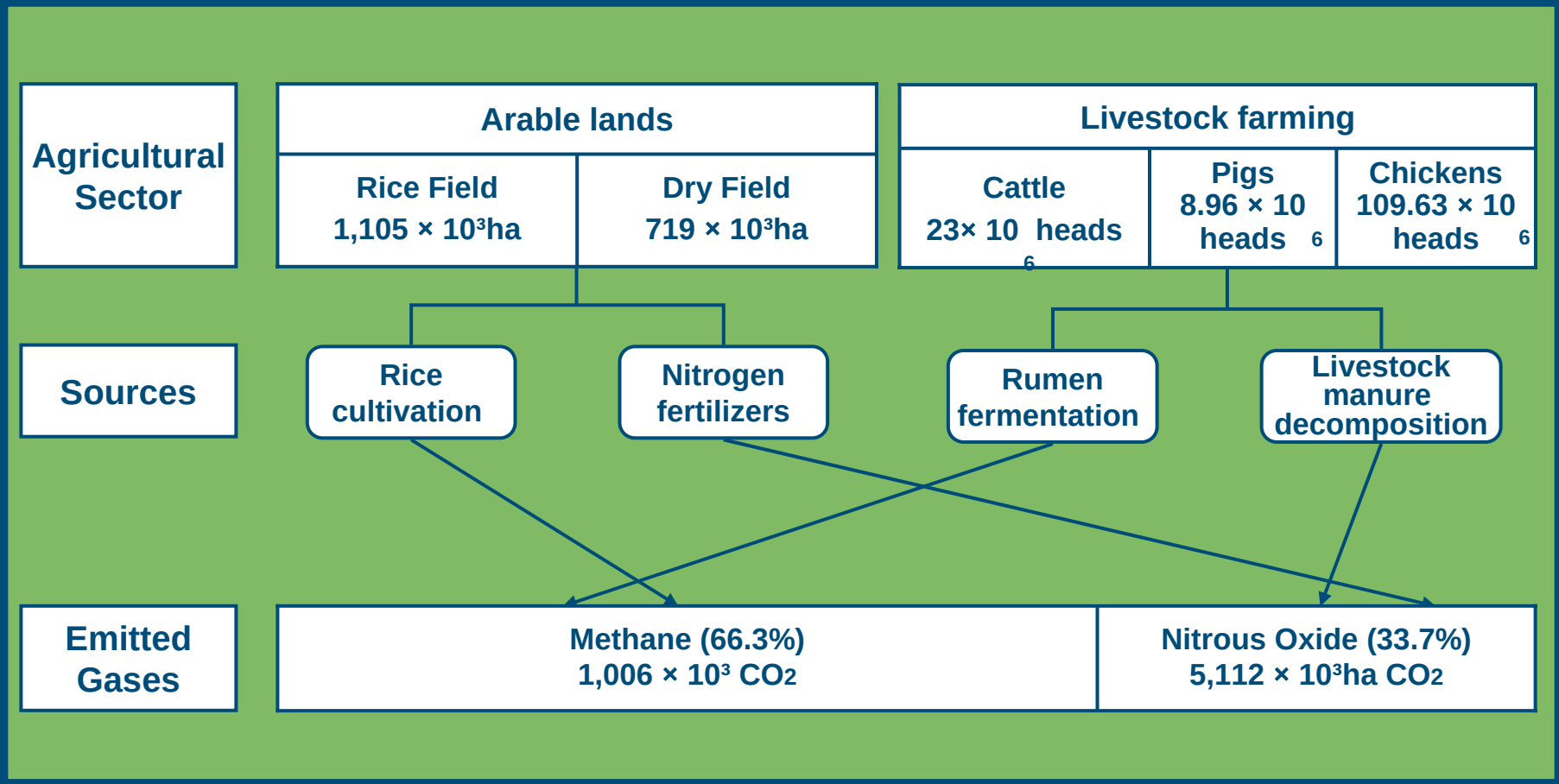
- Increasing 5% in 2001-2030 based on 1970-2000

II Current Status and Projection of GHGs Emissions

Structure of GHG Emission and Sinks in Ag Sector



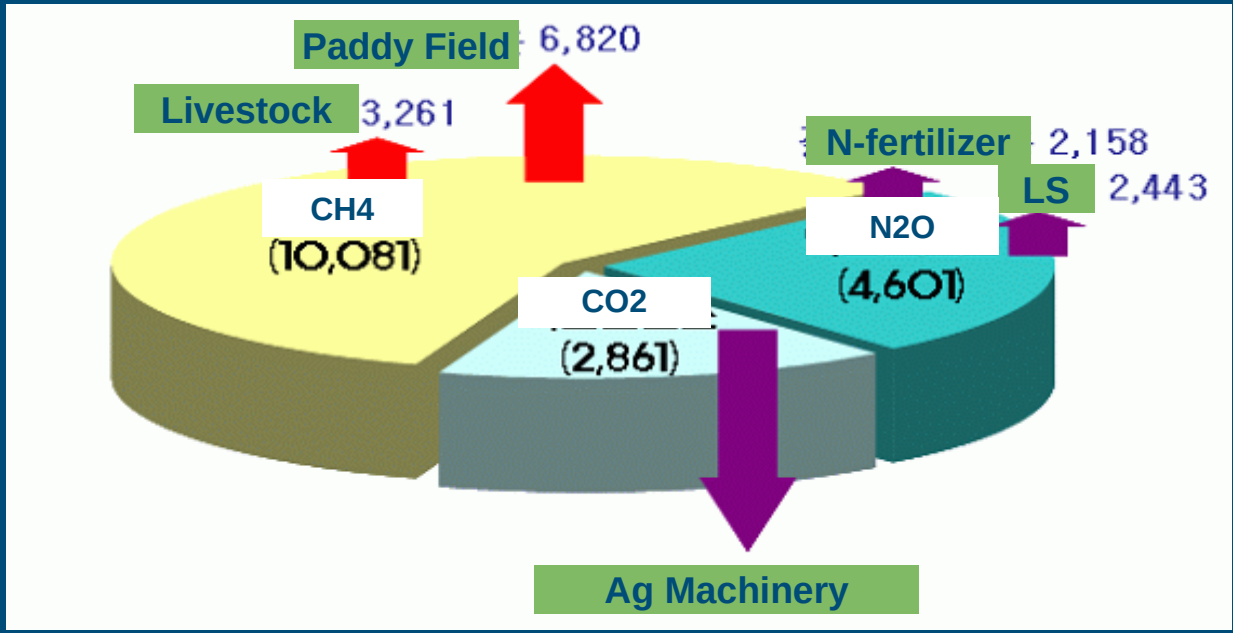
<GHG Emission Structure in the Agricultural Sector (2005)>



Greenhouse Gas Emission (2005)

❑ 14.7 million tons CO_2 emitted from agricultural sector (2.5% of total national GHGs emission)

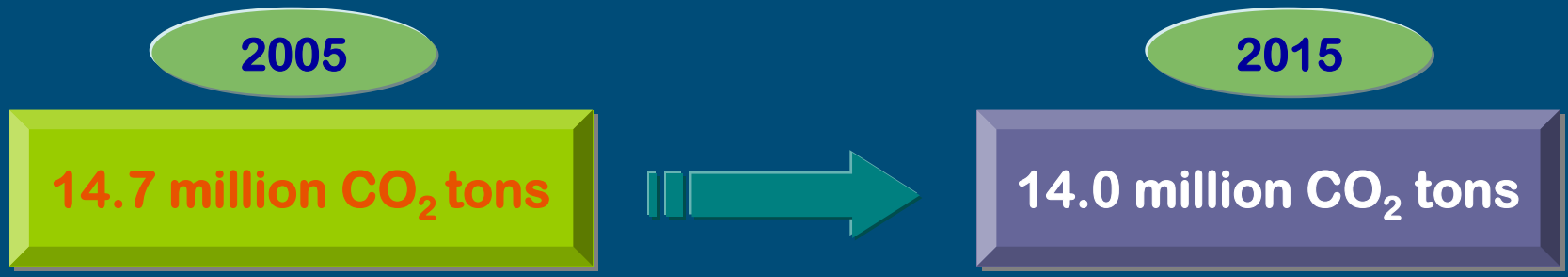
Percentage of emitting source ➡ **Paddy 46.4%, Upland 14.7%**
Intestinal fermentation 20.2%, Manure processing 18.7%



(Unit: thousand CO_2 tons)

Projection of Emission in Ag-Sector (2015)

❑ 4.5% mitigation of CO_2 in agriculture sector by 2015

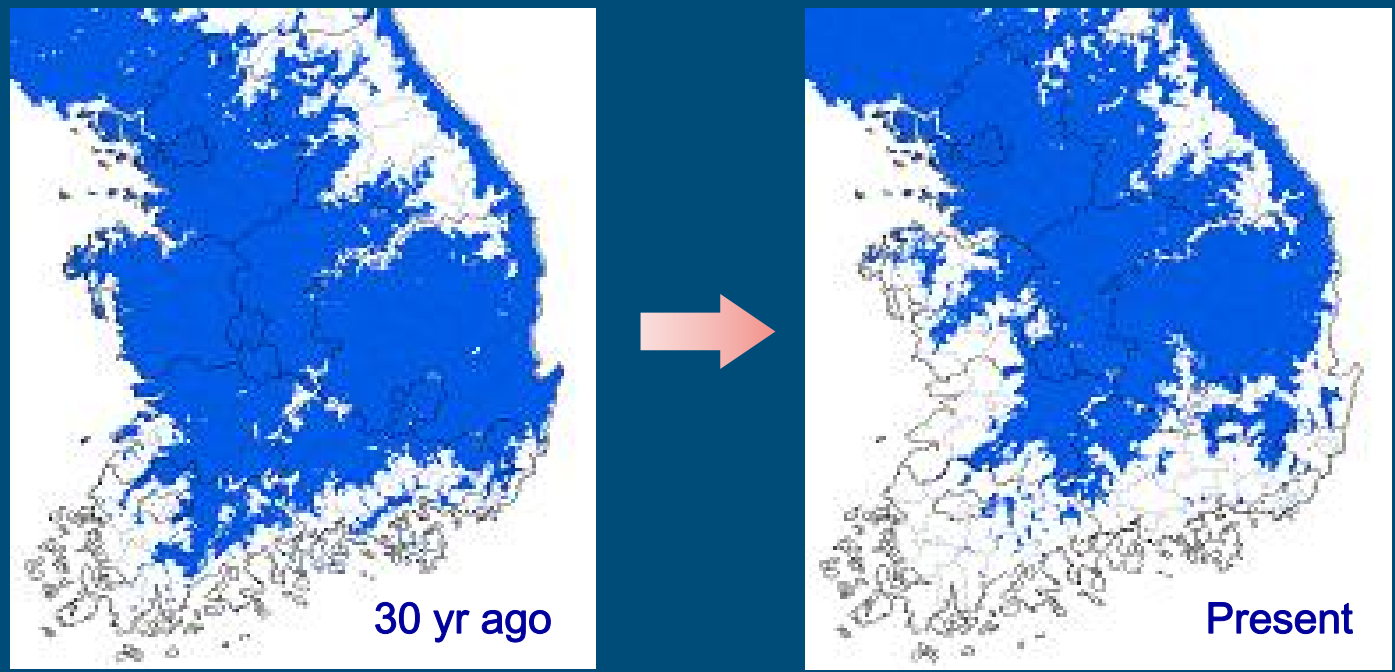


- Emission from Livestock: rise by 15.9% due to the increased number of livestock
- Arable land: reduction by 18.6% due to decrease of cultivation area and fertilizer

III Impacts of Climate Change on Agriculture

1. Change of Suitable Cultivation Area

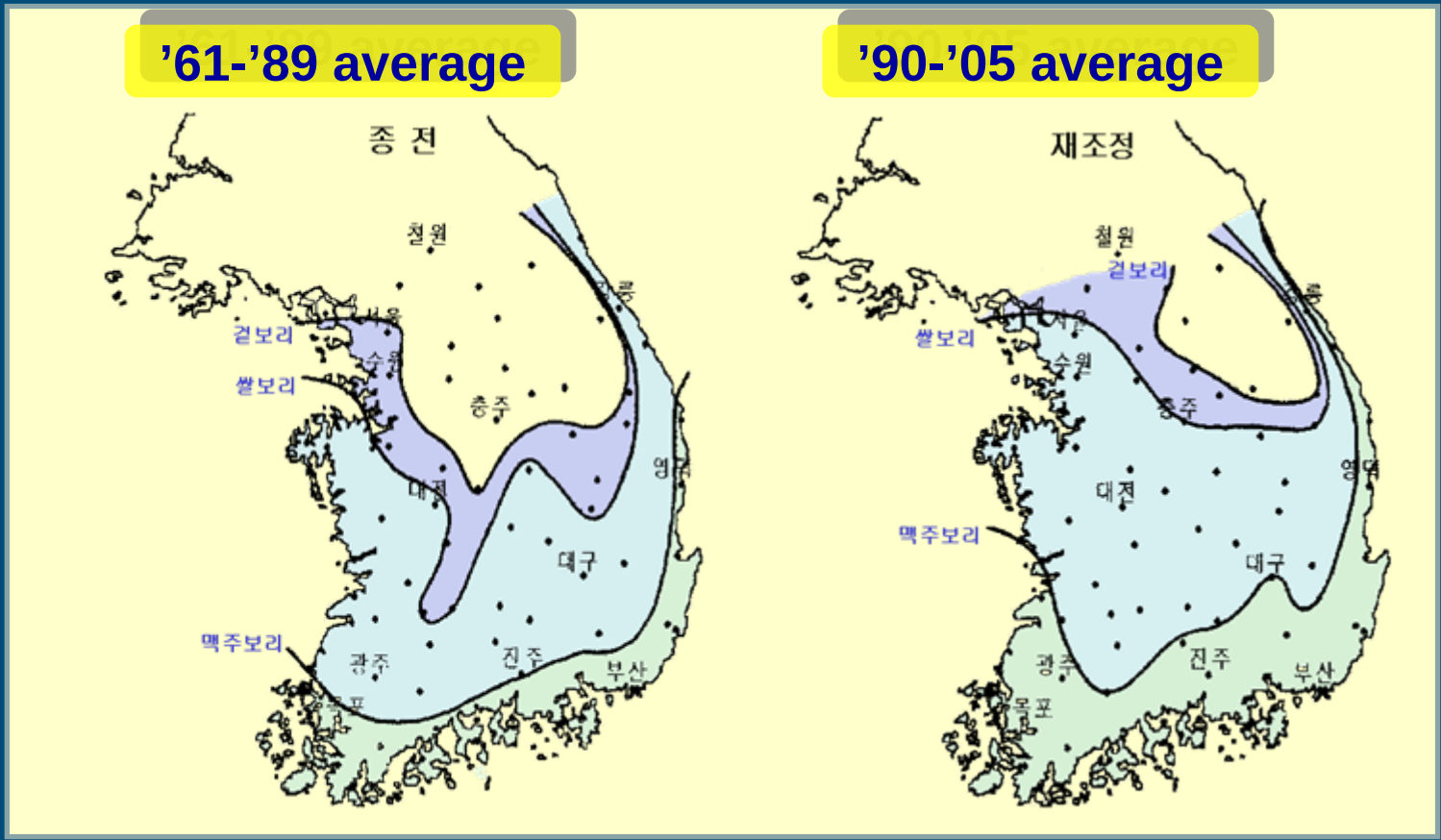
Shift of apple orchards to north



Shift of northern limit for barley cultivation

Naked barley **Chungchung** → **Kyunggi**

Change of Barley Farming Area



< As the winter gets warmer, the cultivation area moves toward the north >

Reduction of Highland Vegetable Area

- ❑ Minimum temperature rise in highlands
  - 1.3℃ (’70s) → 1.6 (’80s) → 2.1 (’90s) → 2.6 (’00~‘05)
- ❑ Highlands (>600m) ⇒ Semi-highlands
- ❑ Semi-highlands (400~600m) ⇒ Plain area

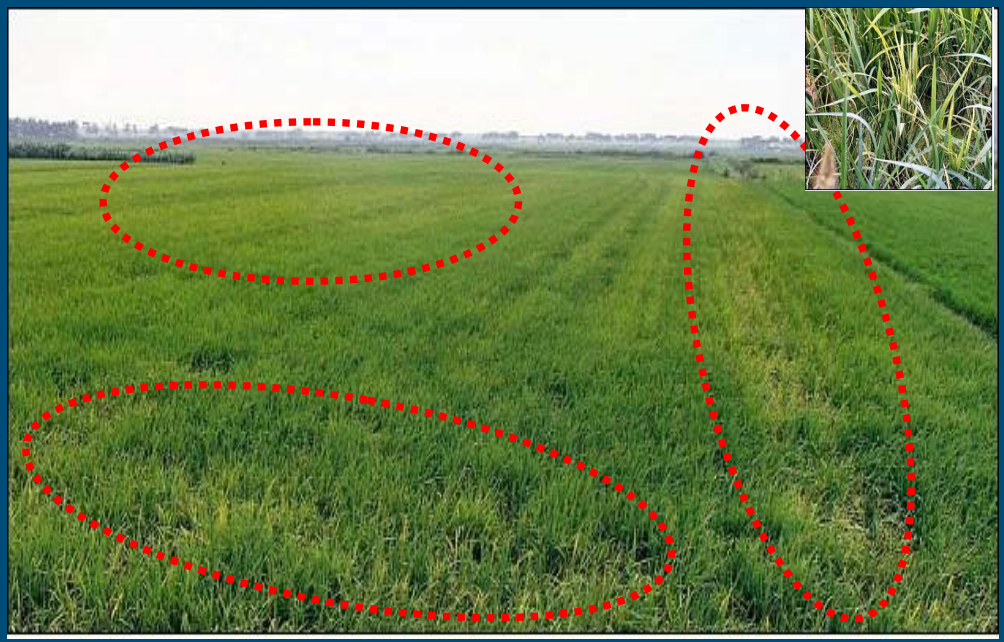
⇨ (Semi) Highland vegetable farming area (predicted)

- 89% reduction upon 2℃ rise (NIAST, 2007)

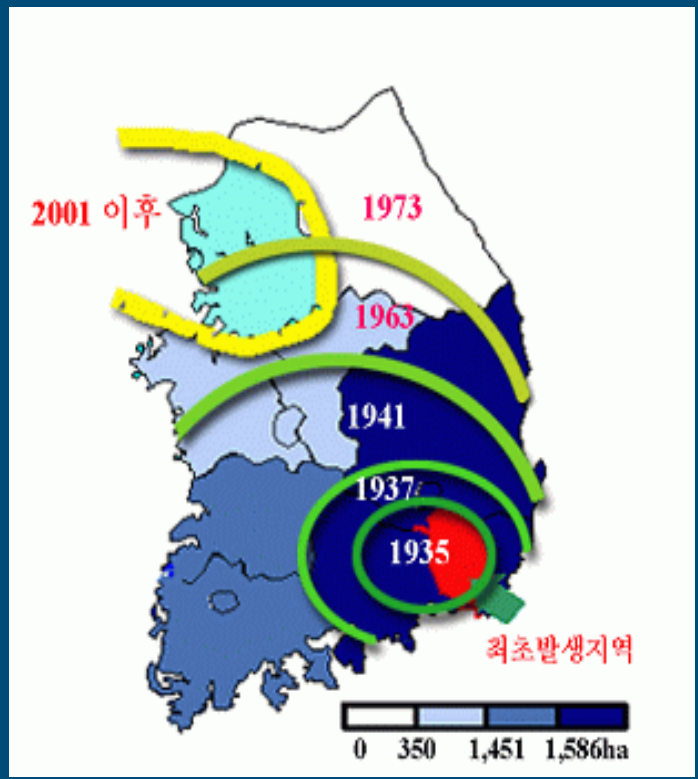
2. Increase of Disease and Insect Pest

❑ Widespread Rice Stripe Virus

- (’01) 20ha ⇒ (’07) 14,137 ha



< Symptom>



<Spreading to northern area>

❑ Outbreak of Ussuri Brown Katydid

- (’01) initiated in Chungju city ⇒ (’06) whole Chungbuk prov.(20ha)
  ⇒ (’07) whole Chungnam & Chungbuk prov.(30ha)

< Peach-chewing brown katydid>

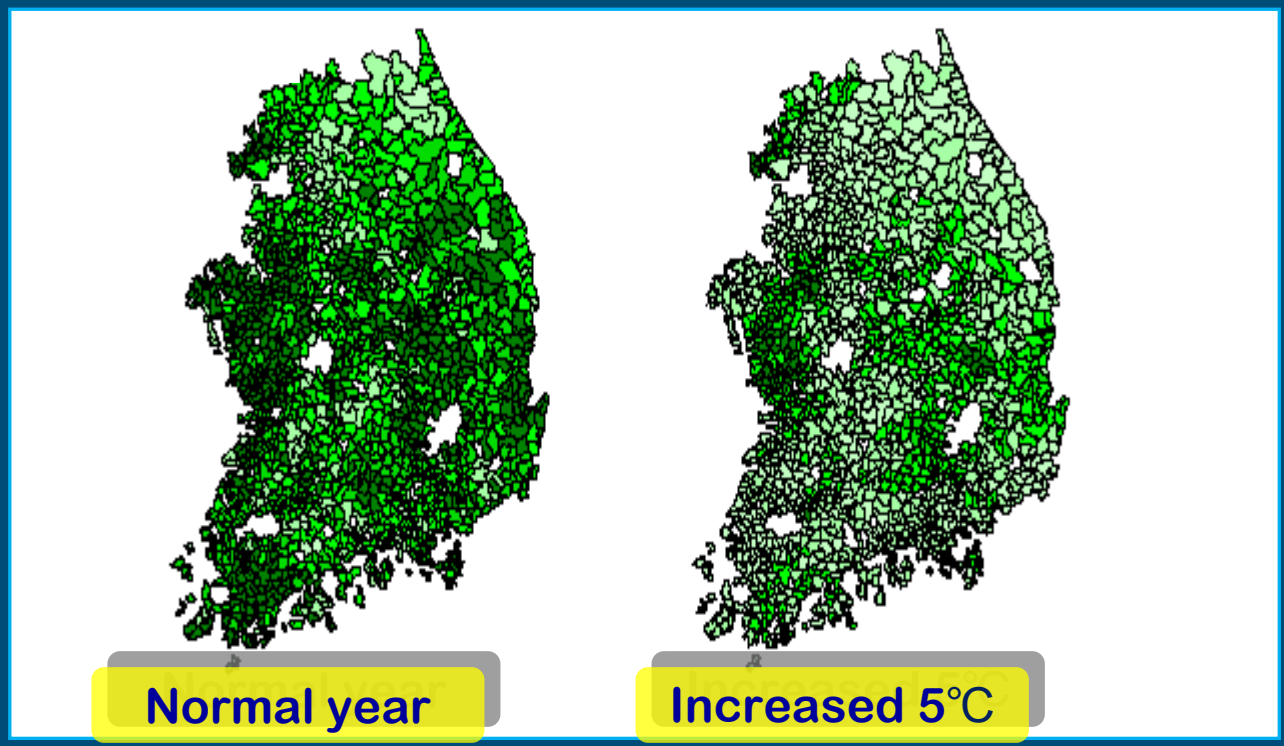
< Damaged apple and peach >

3. Change of Crop Productivity

❑ Reduced growth duration & early flowering

- 2~5 ℃ temperature increase leads to reduction of growth duration by 9~36 days, **15% yields loss** (CERES-Rice Model)

Prediction of Rice Production

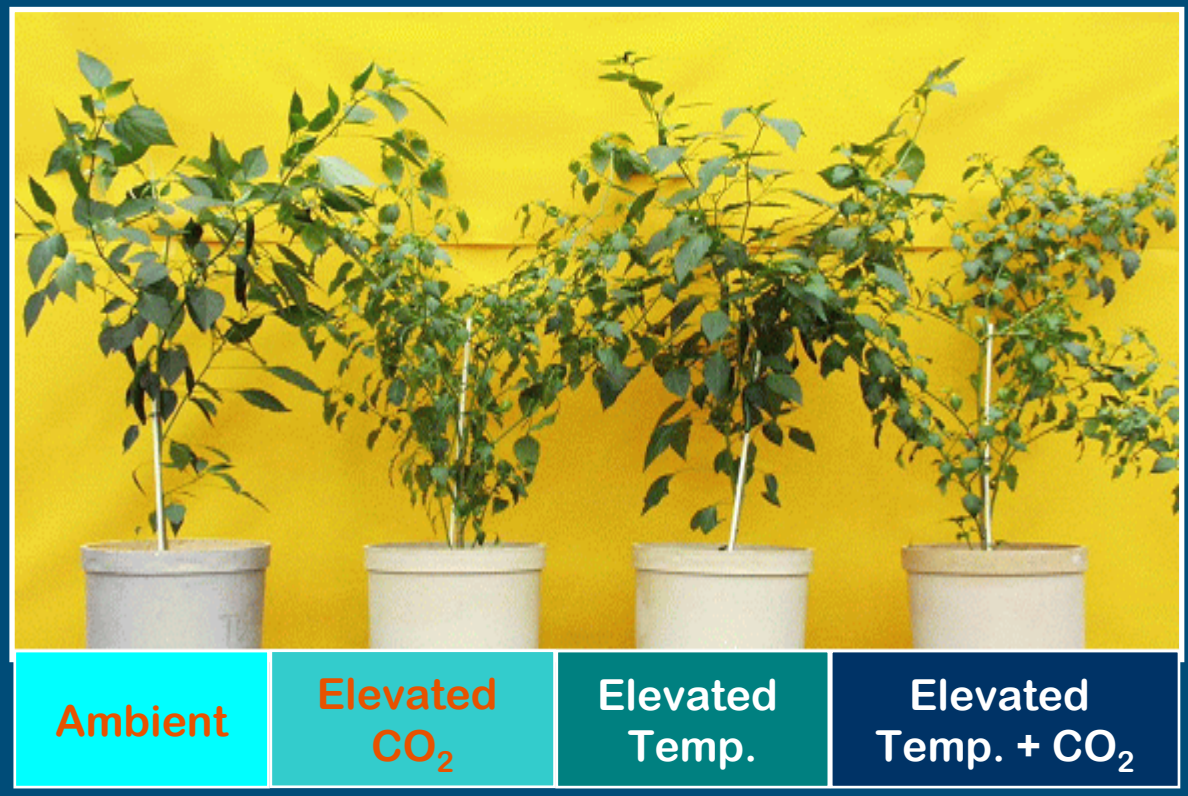


Prediction (kg/10a)
- No data
- Below 450
- 451 – 470
- 471 – 610
- 611 – 660
- Over 661

< 5℃ increase causes significant drop in rice yields >

❑ Delayed growth and yield reduction in red pepper

- Elevated CO_2 → Decreased leaf size and late fruit set
- Concomitant CO_2 & temp. rise → Poor growth & yield loss



4. Livestock Productivity and Respiratory Disease

- **Decreases in milk production due to high-temp.**
  - **Temperature rise (20 → 30℃) : reduction in milk production(6.6%)**
  - **Temperature rise (28 → 32℃) : pig weight loss (13.3%)**
- Respiratory diseases caused by yellow dust

Without ventilation

With ventilation

IV Countermeasures for GHGs Control in Ag-Sector

Basic Directions for Establishing Low Carbon Ag System

- ❑ Threatening management with taking into an opportunity
  - Pest, climate damage, quality deterioration
  - → Resistance improvement
- ❑ Policy Mix through Policy Integration and Coordination
- ❑ Strengthening Research Activities to Develop New Cultivars, Alternative Crops etc.

<Framework of Countermeasures in Korea>

Establishment of Eco-friendly Low Carbon Ag System

GHG emission reduction

- Extension of GHG emissions reduction technology.
- GHG emissions reduction incentive
- Promotion of sound organic farming
- Setting up a foundation of utilizing Kyoto Mechanism.

Carbon sinks

- Extension of carbon sequestration techniques.
- Encourage farmers to grow bio-energy crops
- Commercialize bio-gas plant from livestock manure.
- Identify carbon sinks and sequestration in farmlands.

Adaptation to climate changes

- Establishment of ecological monitoring system.
- Setting up climate information system
- Development of adaptation in climate changes and R&D

Setting up global warming and adaptive system to climate changes

- Establishment of national GHG emissions inventory, developing domestic emissions factor
- Identification of GHG emissions / sinks mechanism and establishing carbon balance model
- Estimation crop production quantity, predicting agricultural flora, and setting up adaptive system (early warning system in agricultural sector)

<Roadmap for Activating Countermeasures>

	Initial stage (2008 - 2012)	Interim stage (2013 - 2018)	Final stage (2019 - 2030)
GHG Emissions Reduction	Provide subsidy &supports Energy saving campaigns Develop and spread GHG emissions reduction Increase bio-energy crops Execute emission trading system/ CDM pilot project	Set up GHG emissions DB. Establish bio-energy production system Establish emission trading system	Supplement GHG emission reduction programs. Set up low carbon farming system. Establish GHG reduction BMP
GHG Sinks	Clarify organic carbon's role in soils Estimate accumulated organic carbon and set up a system of using it	Apply incentives and programs for carbon sinks. Make pubic the methods of using sink sources.	Utilize GHG sinks. Set up maximized carbon sink farming system
Adaptation to Climate Change	Establish the model for productivity forecast and flora evaluation. Set up eco agricultural monitoring system. Map out adaptive croplands and crop distribution. Develop adaptive species to climate changes.	Prepare and distribute anti-global warming manuals. Set up weather info & early warning system. Set up adaptation to climate changes & training system	Distribute adaptation manuals Set up adaptation system Set up crop transformation evaluation system

Core Projects for Practicing Strategies

The 4th Comprehensive Projects to Climate Change

- 10 Ag Projects in Ag-sector

  - GHG statistics (3), GHG Reductions (3), Climate Change Projection and Adaptation (1), Research & Development (3)

  - National Emission Parameters, Ag Emission Inventory, Ag GHG Consumption Statistics

  - Methane Emission Reductions, Supporting Cultivation of Rapeseed for Bio-diesel

  - Reduction Project of Nitrogen Fertilizer

  - Development of Technique of Carbon Sink, Carbon Sequestration

<Comprehensive Projects (2008-2012)>

Fields	Project Name	Authority
GHG Statistics (3)	National Inventory Establishment -Agricultural Inventory Establishment	RDA (joint works)
	National GHG Emission Factor Development & Management -Nation's Agricultural Emissions Factor Development.	RDA (joint works)
	GHG Consumption Statistics Establishment -Agricultural GHG Demand Info System Establishment.	RDA (joint works)
GHG Reduction (3)	Nitrogen Fertilizer Reduction	MIFAFF
	Livestock Methane Emissions Reduction.	MIFAFF
	Recyclable Energy Production & Distribution -Rapeseed Production for Biodiesel	RDA (joint works)
Prospects Adaptation (1)	Nationwide Comprehensive Effects Evaluation & Measures Establishment -Prospective harvest and good croplands from climate changes -Evaluation of the effects of climate changes on agricultural flora	RDA (joint works)
Research and Development (3)	Study on Adaptive Bioenergy Crops Production	RDA
	Study on Alternative Energy Using Biomass Resources	RDA
	Study on Agricultural Carbon Storage Analysis and Carbon Balance Study	RDA

Threats ⇒ Minimizing Negative Impacts

❑ Adaptability mapping to localize suitable crop species

- DB establishment for soil & water environments

- Analysis for local weather & development of preventing technologies from climate damage

- To minimize crop damage from erratic climate such as downpour, heavy snow, etc.

❑ Pest management and stress-relieving technologies

- Pest management technologies (rice virus, brown plant hopper)
  - Utilization of gene-chips for rapid pest control
  - Monitoring pests and weeds on whole country level
- Stabilization of fruit ripening, strengthening stress-resistance

Paratlanticus ussuriensis

Lycorma delicatula

Ceratistis capitata

❑ Improvement of livestock housing and safety management

- Livestock management technologies under high temperature
- Production of forage crops during winter crop season

Tall fescue
(Stress-resistant)

Warm season grass
(High temp-resistant)

Opportunity ⇒ Maximizing Positive Impacts

❑ Development of Low Carbon Ag-Technologies

- Reduction of greenhouse gas emission in crop practices
  - Substitution of green cover crops for chemical fertilizer
  - Dry-seeding of rice & intermittent flow irrigation for methane reduction
  - Methane emission reduced by selecting varieties in rice cultivation
- Reduction of methane gas by improvement of livestock manure
- Reduction of methane gas by controlling intestinal fermentation in ruminant

❑ Renewable & bio-energy, alternative to fossil fuel

- Bioenergy production
  - Rapeseed and Soybean for Bio-diesel
  - Sweet Potato and Corn for Bio-ethanol

- Natural resources, bio-gas utilizing livestock manure

❑ Breeding new varieties adaptable to warmer Korea

- Rice : better grain filling under high temperature condition
- Apple, pear : development of high temp.-adaptable cultivars
- Highland vegetables : wide adaptability
- Sub-tropical fruit trees : inland adaptability
- Introduction of tropical fruits (Mango, papaya, kiwi, etc)

Mango

Pitaya

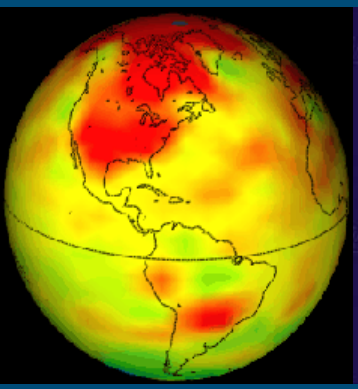
Asparagus

Artichoke

Policy Mix and Integration

- Introduction of Environ. Cross Compliance Program
  - Supporting low-carbon agricultural production systems
  - Promotion of Sound Organic Farming
  - Expansion of Supporting Bio-Energy Production
- Systematic Research and Technology Development
- Establishment of and Integrated Management Systems
- Ensuring Manpower in Exclusive Charge of Climate Change Issues

V Concluding Remarks







Suggestions for the PFSO Meeting

▸ Second Best Solution for Utilizing Opportunity through Overcoming Threat

- Policy Mix
- Market-based Programs (Emission Trading System)
- Environmental Cross-Compliance Progam
- Development of Low-Carbon Technology, R&D

▸ Systematic and Step-by-Step Approach to Climate Change Issue

▸ Networking for Information Sharing, Benchmarking and Research Cooperation

Thanks for your attention!!

Appendix 1: Performance of Low-Carbon Green Technology (OECD, 2007)

Measure	Examples	Mitigative Effect			Net Mitigation	
		CO2	CH4	N2O	Agreement	Evidence
Cropland management	Nutrient management	+		+	***	**
	Tillage/residue management	+		+/-	**	**
	Water management (irrigation)	+/-		+	*	*
	Rice management	+/-	+	+/-	**	**
	Agro-forestry	+		+/-	***	*
	Set-aside, land-use change	+	+	+	***	***
Grazing land management/ pasture improvement	Increased productivity (fertilization)	+			**	*
	Grazing intensity	+/-	+/-	+/-	*	*
	Nutrient management	+			**	**
	Fire management	+	+	+	*	*
	Species introduction	+			*	**
management of organic soils	Avoid Drainage of wetlands	+	-	-	**	**
Restoration of degraded lands	Erosion control, organic amendments, nutrient amendments	+			***	**
Livestock management	Improved feeding practices		+	+	***	***
	Specific agents and dietary additives		+		**	***
	Longer term management changes and animal breeding		+	+	**	*
Manure/biosolid management	Improved storage and handling		+	+/-	***	**
	Anaerobic digestion		+	+/-	***	*
	More efficient use as nutrient source	+		+	***	**
Bio-energy	Energy crops, solid, liquid, biogas	+	+/-	+/-	***	**

Appendix 2: Methods of Adaptation/Mitigation in Agricultural Sector (FAO, 2008)

	Classification	Major contents
Adaptation	Adaptation option/strategy	Adjustment of planting dates and crop variety; crop relocation; improved land management, e.g. erosion control and soil protection
	Underlying policy framework	R&D policies; institutional reform; land tenure and land reform; training; capacity building; crop insurance; financial incentives, e.g. subsidies and tax credits
	Key constraints and opportunities to implementation	Technological and financial constraints; access to new varieties; markets; longer growing season in higher latitudes; revenues from ‘‘new’‘ products
Mitigation	Key mitigation technologies and practices	Improved crop and grazing land management; restoration of cultivated peaty soils and degraded lands; improved rice cultivation techniques and livestock and manure management; improved nitrogen fertilizer application techniques; dedicated energy crops to replace fossil fuel use; improved energy efficiency; improvements of crop yields
	Policies and measures	Financial incentives and regulations for improved land management; maintaining soil carbon content; efficient use of fertilizers
	Key constraints or opportunities	May encourage synergy with sustainable development and with reducing vulnerability to climate change, thereby overcoming barriers to Implementation