

Climate Change Issues and Future Agricultural Farming

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Climate Change is the defining issue of our time and we are at a defining moment. From shifting weather patterns that threaten food production, to rising sea levels that increase the risk of catastrophic flooding, the impacts of climate change are global in scope and unprecedented in scale. Without drastic action today, adapting to these impacts in the future will be more difficult and costly.

The IPCC Fifth Assessment Report(AR5) provides an important message that human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history and recent climate changes have had widespread impacts human and natural systems.

Based on the overall knowledge of meteorology, climatology and climate change science, the interactions between agricultural and forest ecosystems and climate system such as food production, resource management, and ecosystem service are reviewed, analyzed and understood in the framework of system thinking. The impacts of climate change on water, energy and material exchanges, high impact weather, disease, crop production, and ecosystem management are assessed and projected. Students learn about the adaptation and mitigation for the climate change in the fields of agriculture and forest.

Climate Smart Agriculture(CSA) is an approach for developing agricultural strategies to secure sustainable food security under climate change. CSA aims to tackle three main objectives : sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions.

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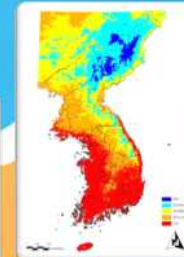
The 20th Anniversary Workshop on Korean Society of Agricultural and Forest Meteorology
29 August 2019, Jeju Korea.



Climate Change and Future Agricultural Farming

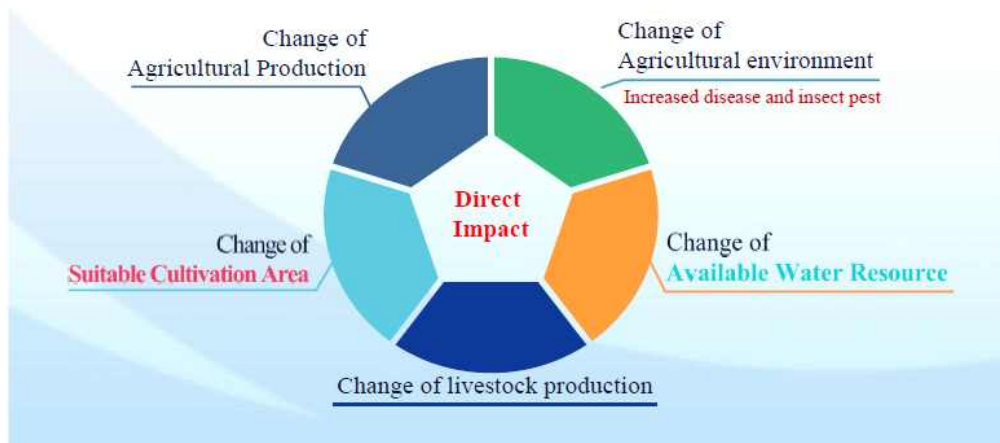


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Climate Change and Agriculture

- ❖ Agriculture is **highly climate-dependent**, **very vulnerable to climate change**, and it is imperative to take proactive measures at the national level to address climate change and to ensure **food security**.
- ❖ Abnormal weather damage, change of cultivation area, increased winter pest damage



남4 Climate Change and Food Security

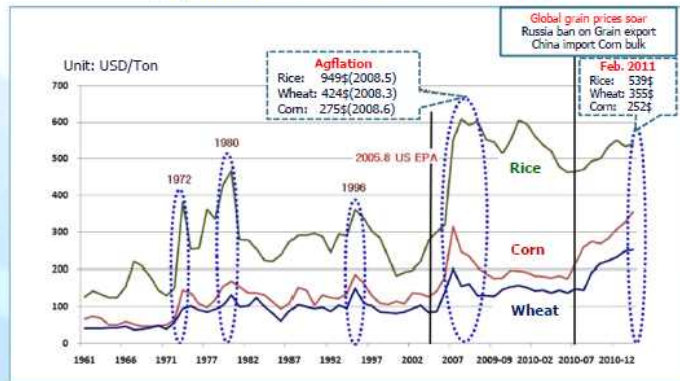
Food security?

People are considered food secure when they have availability and adequate access at all times to **sufficient, safe, nutritious food** to maintain a healthy and active life

Food crisis or Food insecurity?

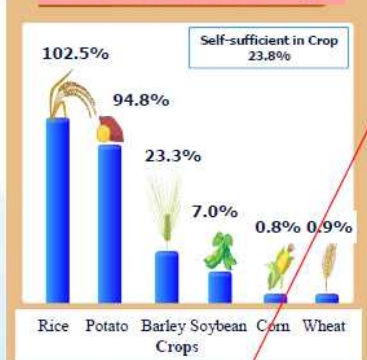
The **food crisis** is a symptom of a food system in crisis **due to extreme weather**, high oil prices etc. global food system is highly vulnerable to **economic and environmental shock**.

(Agflation due to extreme weather in 2008)



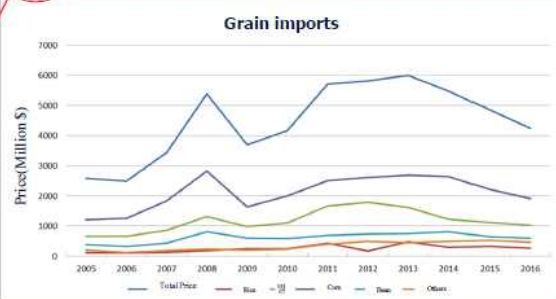
Food Security in Korea

2016 Self-sufficient in Crop



Grain imports for 2016

Total Amount	Rice	Wheat	Corn	Soybean	Others
16,562	4,255	340	265	4,461	1,023
	9,813	1,909	1,327	597	621
	461				



The **soar in grain prices** was occurred due to extreme weather of Climate change. From the end of 2007 to the beginning of 2008 **Grain price skyrocketing**. In some countries in **Asia and Africa** Protests and riots took place.

2008 Agflation: Agro-Meteorological Disaster

Irish Exodus (1845~1851)

- ❖ Population of Ireland decreased from 8 million to less than 5.5 million in record-breaking famine due to potato poor harvest between 1845 and 1851.
 - Continued rain causes a deadly potato blight to spread throughout Ireland.
- ❖ At least one million people have died of starvation, and more than 2 million have migrated to North America.
 - 10 presidents, including Kennedy and Clinton and great actors, Grace Kelly, Tom Cruise, George Clooney, John Wayne and others are descended from Irish.



Joseon Dynasty Kyeongshin Great Famine

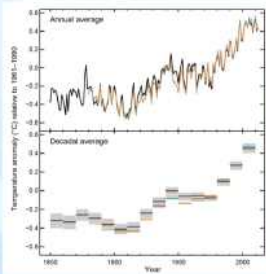
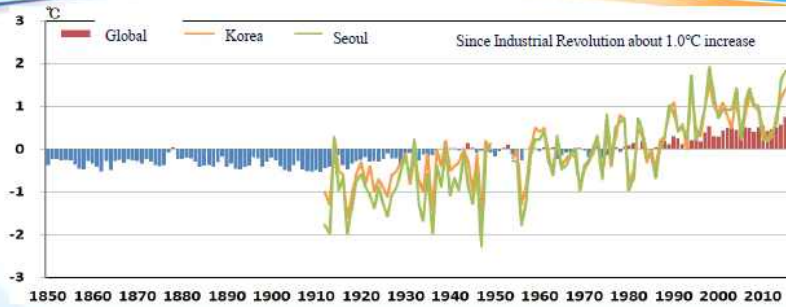
- ❖ Kyeongshin Great Famine was serious famine due to extreme weather such as low temperature, drought, flood, super typhoon, frost, and pests in the little ice ages of 1670 and 1671 at Joseon Dynasty.
- ❖ More than 1 million casualties, epidemic break out, public welfare breakdown, and social unrest



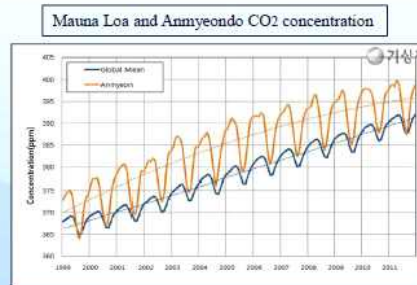
Joseon to Hell
made worst
Natural Disasters

Source:
Duk-Jin Kim(2008)

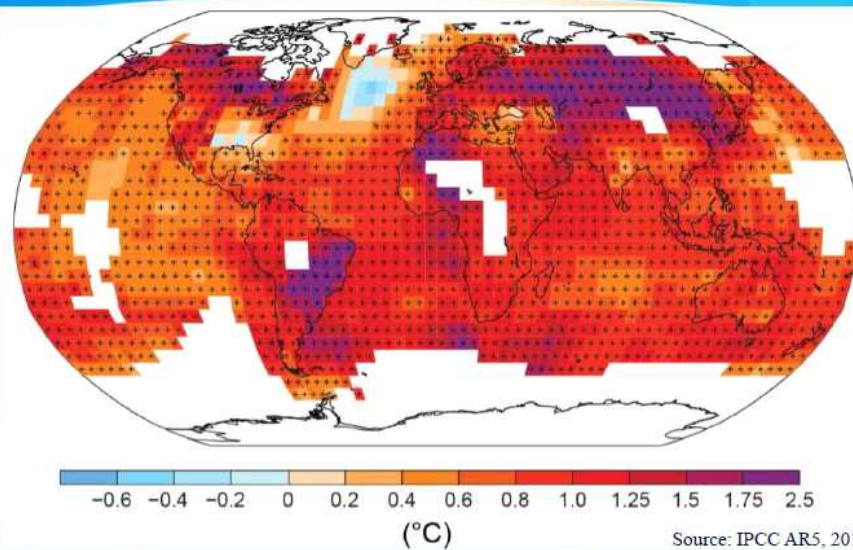
Temperature and CO₂ Concentration



Observed globally averaged combined land and ocean surface temperature anomaly 1850-2012

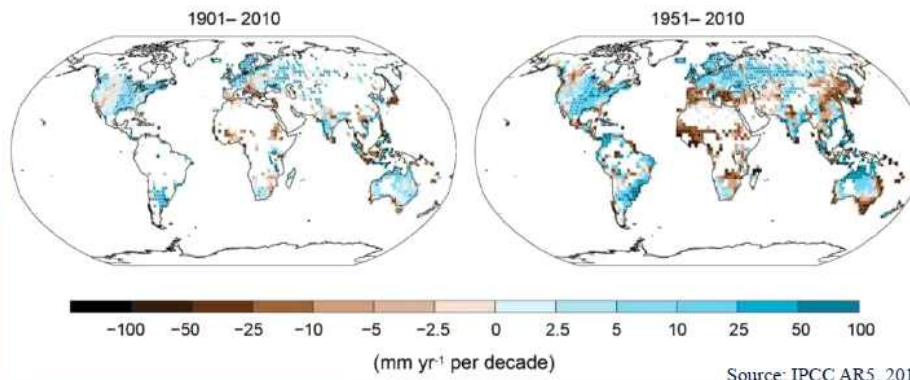


Surface Temperature Change



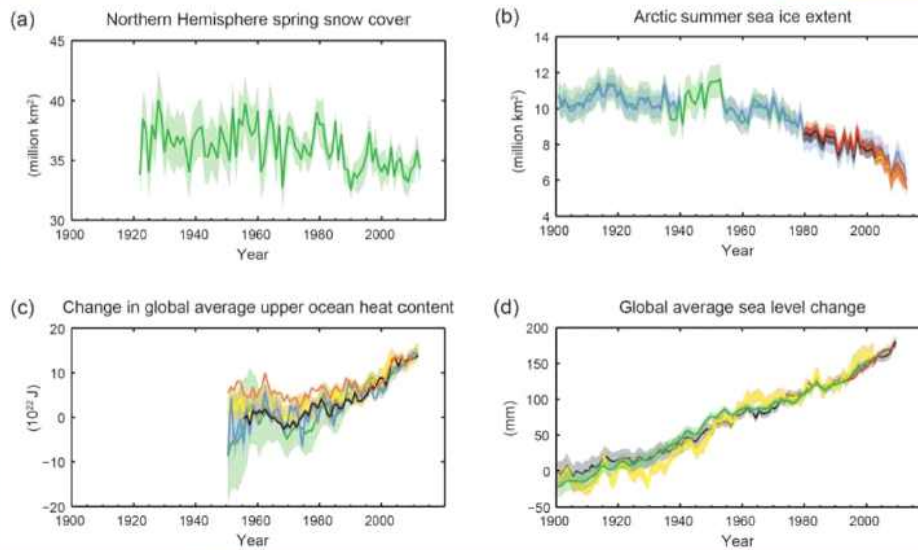
Observed change in surface temperature 1901-2012

Observed Annual Precipitation Change



Observed change in annual precipitation over land

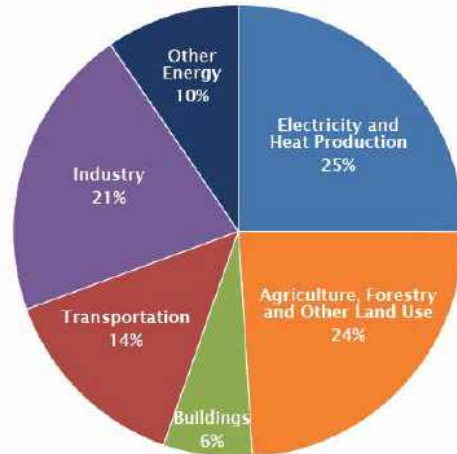
The Evidence of Climate Change



Multiple observed indicators of a changing global climate

Greenhouse Gases Emission in AFOLU

Global Greenhouse Gas Emissions by Economic Sector



Agriculture, Forestry, and Other Land Use

(24% of 2010 global greenhouse gas emissions)

Greenhouse gas emissions from this sector come mostly from agriculture (**cultivation of crops and livestock**) and **deforestation**.

This estimate does not include the CO₂ that ecosystems remove from the atmosphere by sequestering carbon in biomass, dead organic matter, and soils, which offset approximately 20% of emissions from this sector.

The Effect of Climate Change

Ecosystem

- ✓ Endangered Species
- ✓ Intensify desertification
- ✓ Vegetation destruction
- ✓ Natural Forest destroy
- ✓ Increased soil erosion
- ✓ Sea level rise
- ✓ Sewage exclusion



Economy

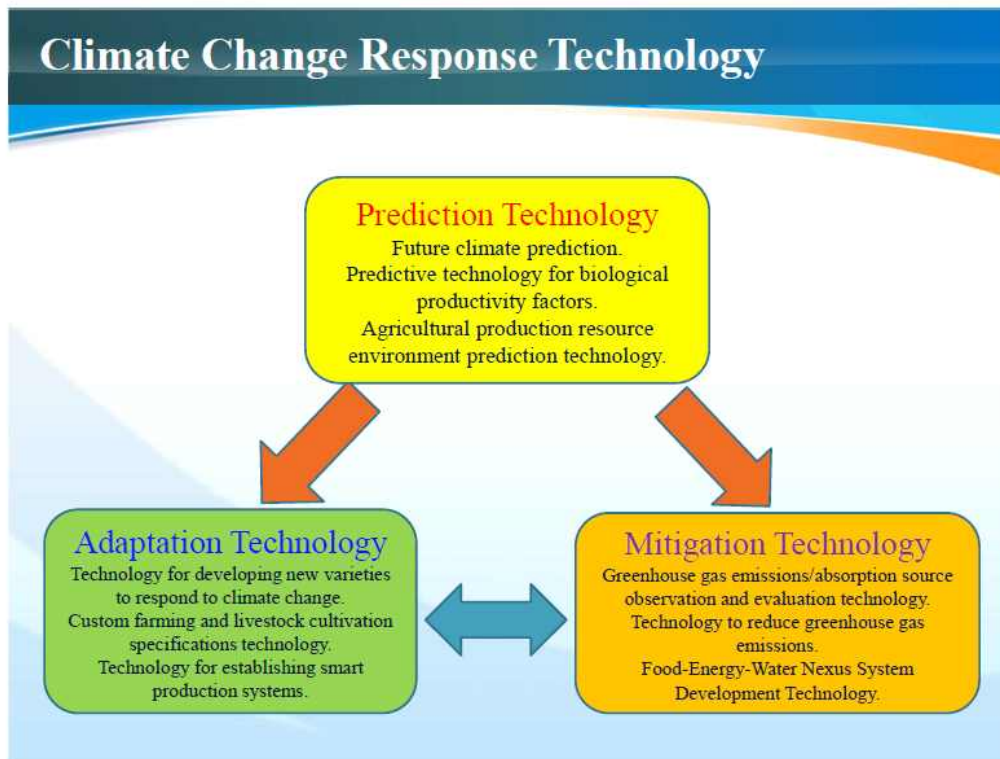
- ✓ Grain prices rises
- ✓ Vegetation prices rise
- ✓ Feed prices rise
- ✓ Consumer prices rise
- ✓ Reduced farm income
- ✓ Increased production costs
- ✓ Rural Economy Shrinking



Society

- ✓ Increased hunger population
- ✓ Stock up heavily with food
- ✓ Maximizing social conflicts
- ✓ Climate Refugees increase
- ✓ Political unrest





Future Technology for Climate Change

Climate Change Prediction Technology

- ✓ Increased demand for observations and forecasts of time-space climate data available in agriculture
- ✓ Changes in crop productivity due to climate change, fragility in the livestock sector and increased demand for pest predictions
- ✓ Increased demand of **climate scenario data for the future productivity of agricultural products**
- ✓ Increased interest in the positive effects of climate change mitigation on agricultural activities
- ✓ Increased concern about negative environmental impacts, such as spills of agricultural nutrients

Digital forecast (3km)

Downscaled data (270m)

Future Technology for Climate Change

Climate Change Adaptation Technology

- ✓ Development technology for **new varieties** of climate change using **genetically modified** and corrected technology.
- ✓ Need to build and materialize DB for the search and introduction of adaptive gene sources in the climate change.
- ✓ Increased need for the transition of the **4th Industrial Revolution technology** such as Drone, Big Data, and ICT convergence concentrated production system
- ✓ Need for resource-to-resource efficiency for sustainable agricultural production
- ✓ Securing technology to relieve livestock supply and demand anxiety and increase self-sufficiency in feed production



New genetically modified varieties



Convergence of 4th Industrial Revolution Technology



Increased production of feed crops

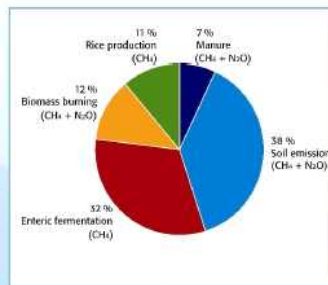
Future Technology for Climate Change

Climate Change Mitigation Technology

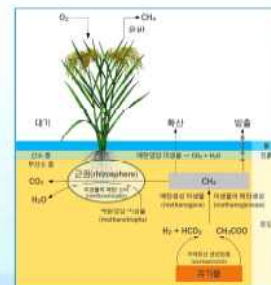
- ✓ November 2016 Paris Climate Change Agreement officially enters into force.
- ✓ 2030 Greenhouse Gas Reduction Roadmap Finalized in July 2018.
- ✓ Greenhouse gas reduction target by **7.9 % compared to BAU by 2030 in agricultural sector.**
- ✓ Establishing an agricultural sector action plan to achieve the reduction target.
- ✓ Development of agricultural sector reduction technology to achieve reduction goals.



Korea's GHGs Reduction Goals

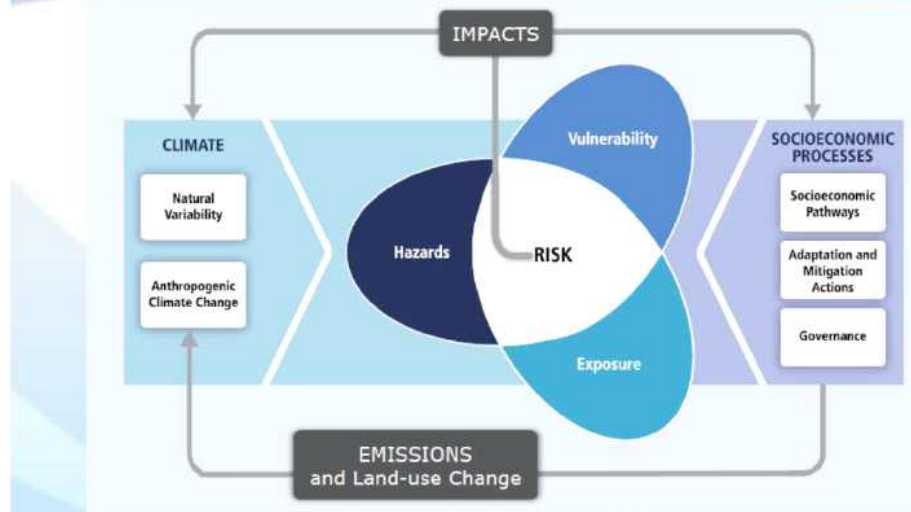


Greenhouse gas emissions in agriculture



Methane production mechanism in rice field

Key Concepts of Climate Change Risks



The risk of climate change-related impacts is decided by the vulnerability and exposure time interactions between the human and natural systems, as well as the climate change hazards.

Vegetable Protein Meat



Beyond's products presented at the 2nd Vegan Festival

It is a vegetable protein extracted from beans, mushrooms and pumpkins, according to **Beyond**, an American food company that makes "meat, not meat.". As an alternative to the existing meat industry, which has been subjected to animal rights infringement and environmental pollution controversy



Frank sausage and Pork Cutlet(dongaseu) made from plant-based protein

The **Veji Food** company, which produces vegetable meat, has been producing **Flank sausages** and **dongaseu (Pork Cutlet)** for the past 20 years.

Water • Food • Energy Nexus



The **water, food and energy nexus** according to the Food and Agriculture Organization of the United Nations (FAO), means that **water security, energy security and food security** are very much linked to one another, meaning that the actions in any one particular area often can have effects in one or both of the other areas. [1] These three sectors (water, energy and food security nexus) are necessary for the benefit of **human well-being, poverty reduction and sustainable development**.

Water-food-energy connections lie at the heart of sustainable, economic and environmental development and protection. The demand for all three resources continues to grow for various reasons: a **growing population**, ongoing population movements from farms to cities, rising incomes, increased desire to spend those incomes on energy and water intensive goods/varying diets, international trade, **urbanization** and **climate change**

Climate Smart Agriculture(CSA/FAO)

Climate Smart Agriculture (CSA) Goals

- ✓ Food productivity and income continue to increase
- ✓ Strengthening resilience to climate change
- ✓ Reducing greenhouse gases contributes to climate change

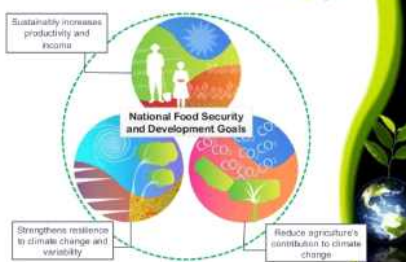
FAO (2010)
(Food and Agricultural Organization)

Food Security Adapting and mitigating climate change



UN Sustainable Development Goals
(UN SDGs)

What is CSA?



Source: Presentation by Irina Papuso and Jimly Faraby, Seminar on Climate Change and Risk Management, May 6, 2013. [3]

SMART Agricultural Farming



Smart Farm



Future Plant Factory

SMART Agricultural Farming

In the era of climate change, our agriculture must go to a **smart farming** where we can predict climate change, foster new varieties that are resistant and resilient to **high impact weather**, and incorporate the **4th industrial revolution technology** to improve agricultural productivity and reduce greenhouse gas emissions.

S	SPEED 속도의 시대
M	MOBILITY 이동성의 시대
A	ADVANTAGEOUSNESS 편리함의 시대
R	RECREATION 즐거움의 시대
T	TELE-COMMUNICATION 전자소통의 시대



Jim Rogers, along with Warren Buffett and George Soros, are among the world's top three investment investors, said **high value-added agriculture** will develop in the **bio-life industry**, **seed industry**, etc.

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The Future of Agricultural Farming?

Bright

Grim

Thank you !



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