

Strategies of Adaptation and Mitigation for Coping with Climate Change: From Aspects of Taiwan Agriculture

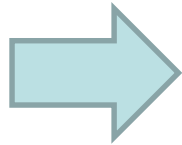
Chwen-Ming Yang



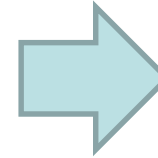
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Outline

A changing climate scenario



Factors affect agriculture under CC



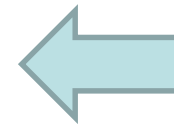
Strategies to cope with CC



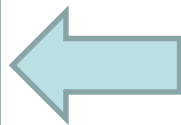
Mitigation strategies to cope with CC



Adaptation strategies to cope with CC



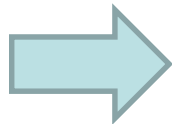
CC impacts on crop yields in Taiwan



Integrated res. projects to cope with CC in Taiwan



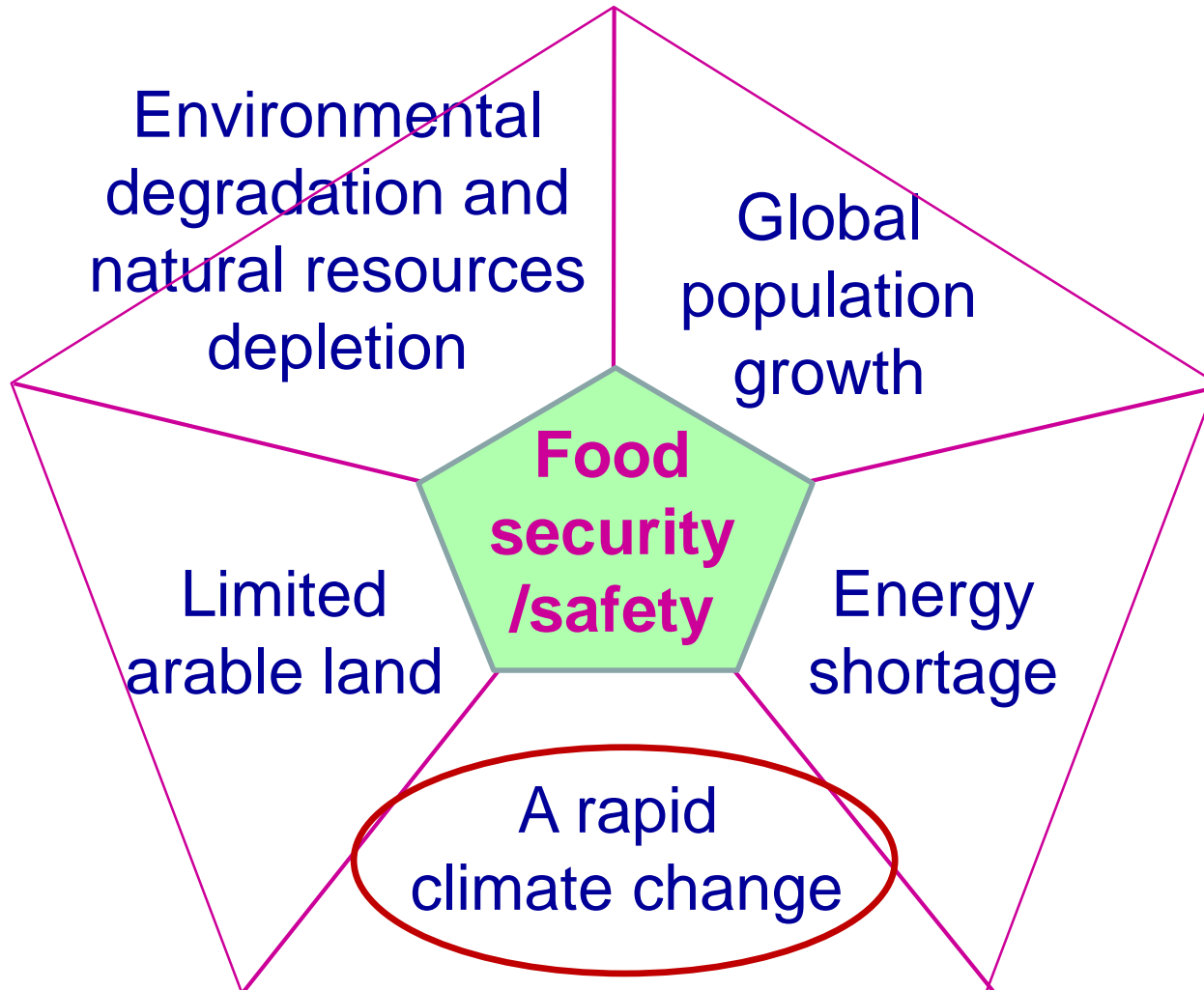
Goals and strategies/themes of the projects



Concluding remarks



Issues of Global Importance



A Changing Climate Scenario

Long-term and mass-consumption of **fossil fuels** and worldwide **deforestation**

anthropogenic drivers

GHG emissions ↑

CO₂, CH₄, N₂O, CFCs...

heat trapping /get hotter

A global warming trend

IPCC 2001, 2007, 2013

A rapid climate change

Surface temp. ↑

Irregular rainfall pattern ↑

Extreme weather event ↑

Sea level ↑

CO₂ conc. ↑

physical evidence

Abnormal weather & climate

bring about impacts

Food security

Agricultural production

so as to affect

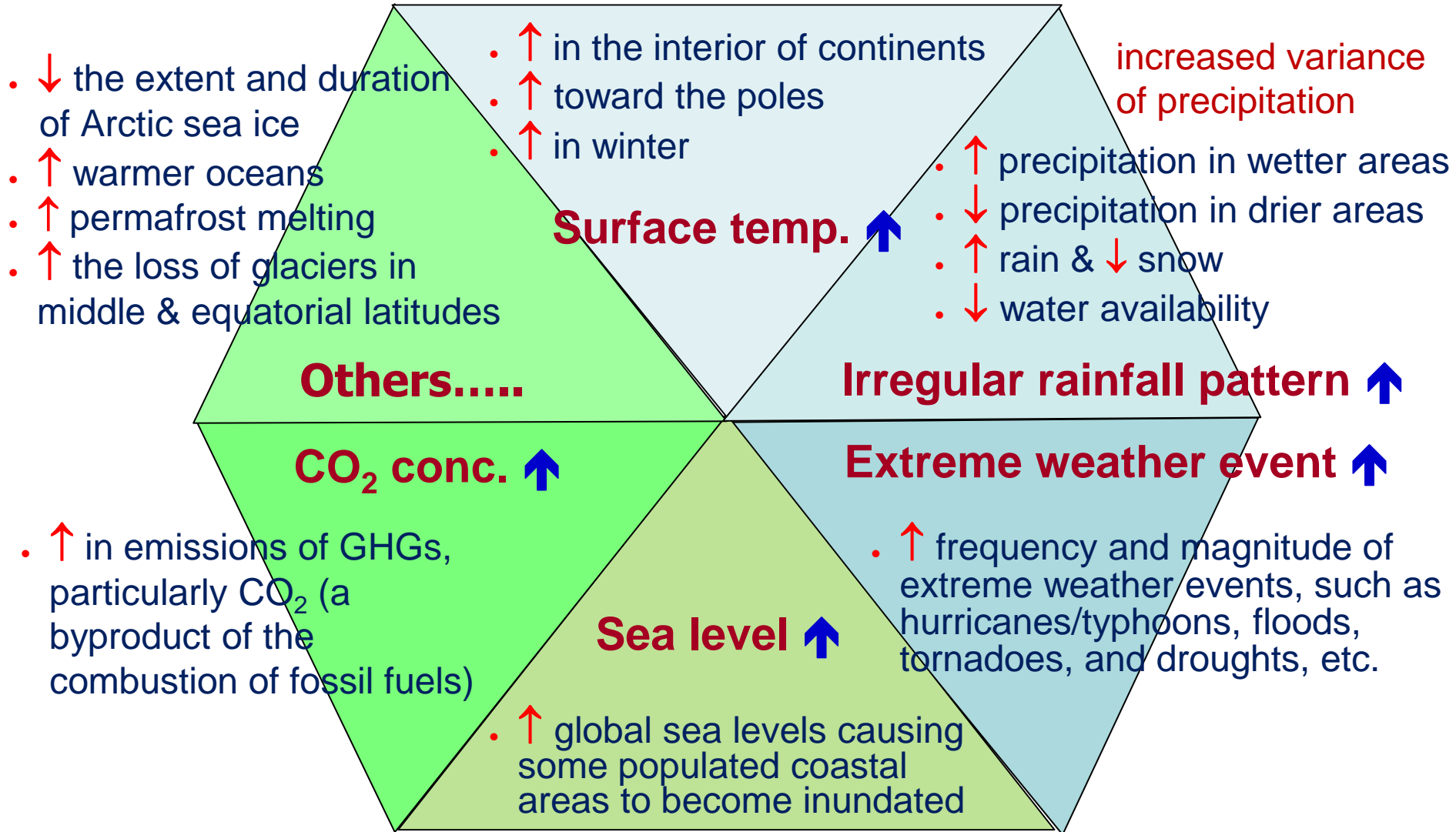
Hydrological systems

Biological & chemical cycles

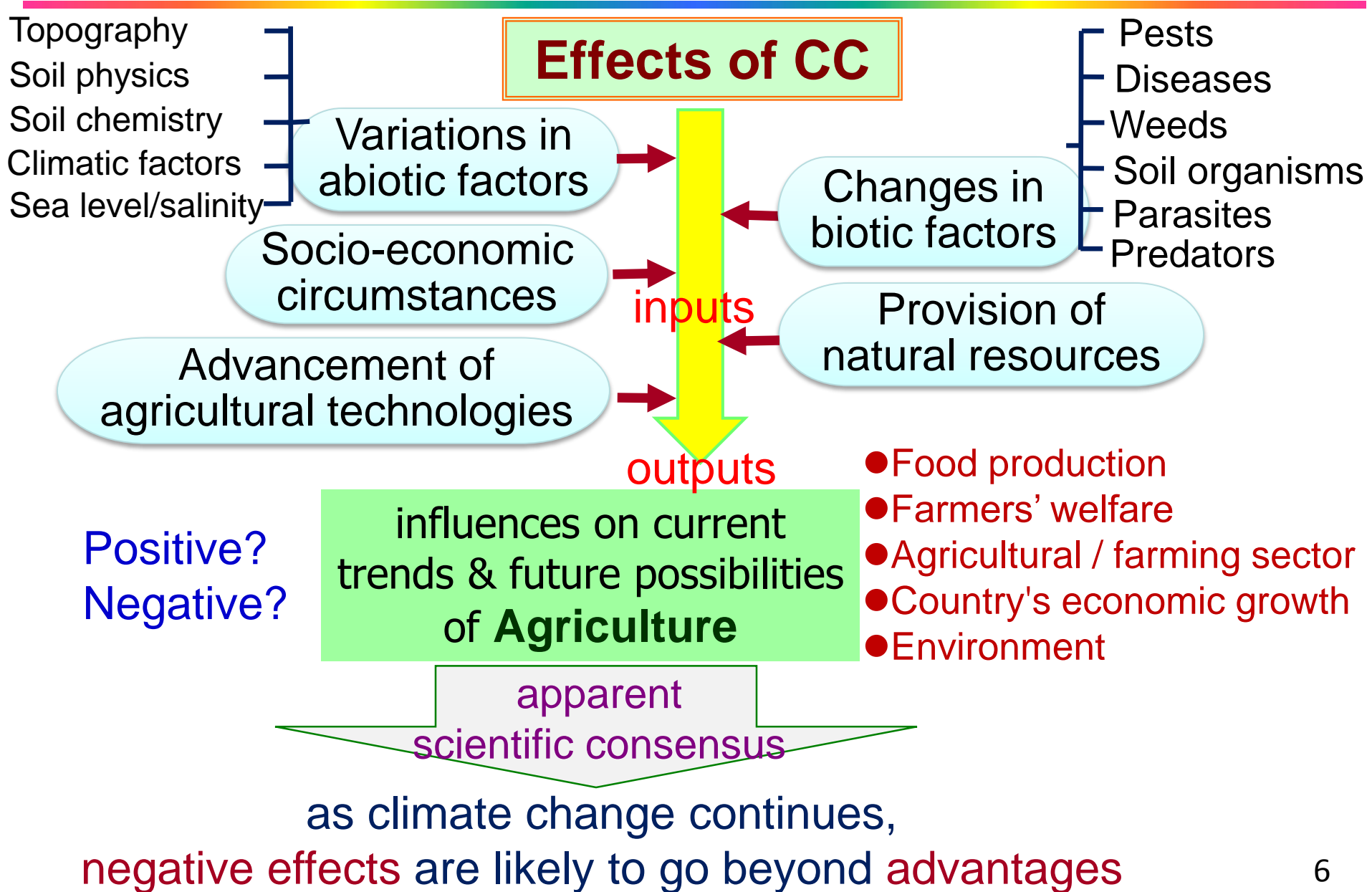
Biodiversity

Ecosystems

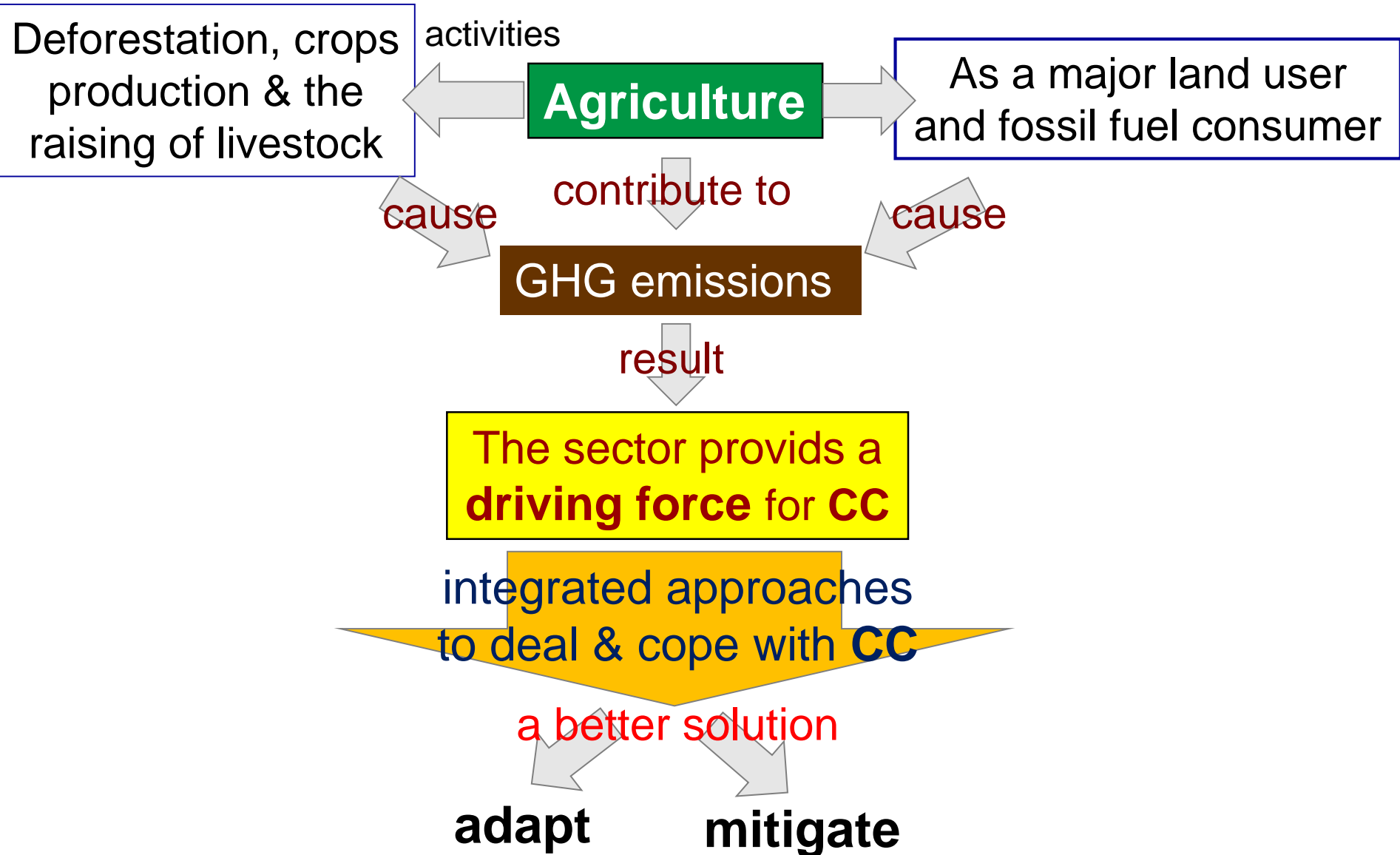
Physical Evidence of Climate Change (CC)



Factors Affect Agriculture under Climate Change/CC

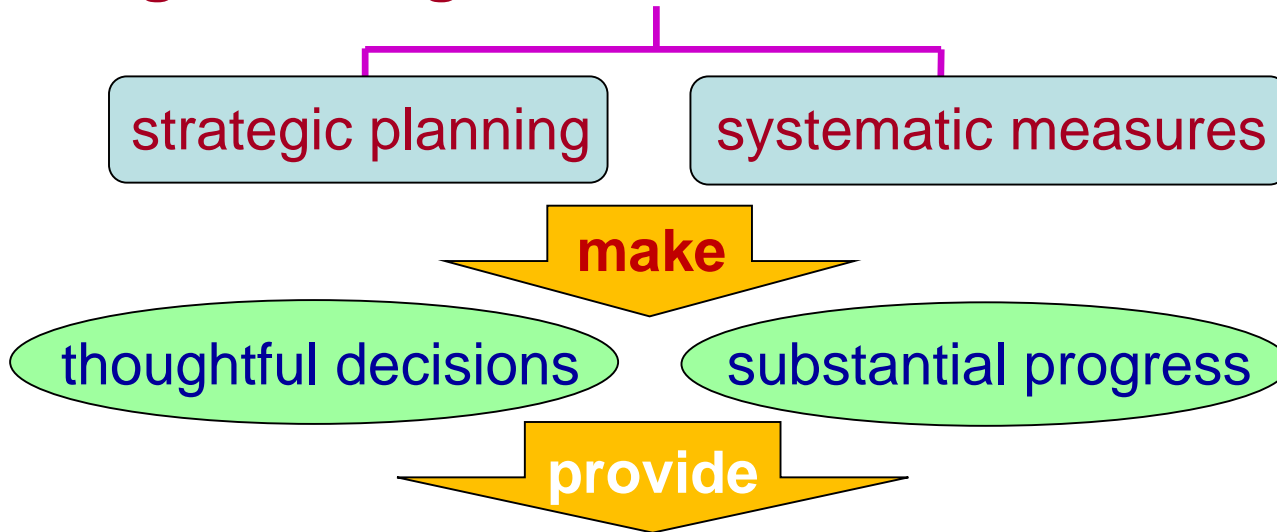


Agricultural Production is a Driving Force for CC



To Do Something to Cope with CC

From the perspective of
global, regional and national levels



Improved practices to ensure food security under CC

Mitigation strategies

Adaptation strategies

by reducing GHG emissions
with a global mitigation effort

examples

by implementing suitable farming
practices with adaptive strategies

the impacts of anthropogenic
CC could be brought down to
a certain degree

possible to improve tolerance
ability and capability for crops to
maintain the productivity

Strategies to Cope with CC

- Global and national initiatives
- Stronger laws and policies

Tony Prato and Dan Fagre, 2006.

Brenda et al., 2008.

Actions to counteract the adverse consequences of **CC**

Adaptive management
(with scientific approach to manage the adverse impacts)

Adaptation

Management intensification in agriculture (more traditional forms of agriculture offer greater potential for adaptation)

➔ can increase resilience of agriculture and lower sensitivity to **CC**

Energy conservation
(cleaner, smarter energy and its uses)

Mitigation

Sustainable practices (in all aspects and at global and national levels)

Actions to prevent, reduce, or slow **CC**

➔ can decrease vulnerability of cropping system and reduce the exposure to **CC**

➔➔ ↓ **adverse impacts of CC**

Mitigation Strategies to Cope with CC

An example, Kyoto Protocol
(adopted in 1997 and effective in 2005)

Energy conservation
(using cleaner and smarter energy)

seeking ways
to slow **CC**

- ✓ . Increasing the use of solar and wind energy in operating agriculture
- ✓ . Cutting down GHG emissions into the atmosphere
- ✓ . Powering the economy/agriculture with renewable energy resources
- . Implementing green construction codes
- . Reducing urban sprawl

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Adaptation Strategies to Cope with CC

Adaptive management

adopting science- & information-based approaches to manage the adverse impacts

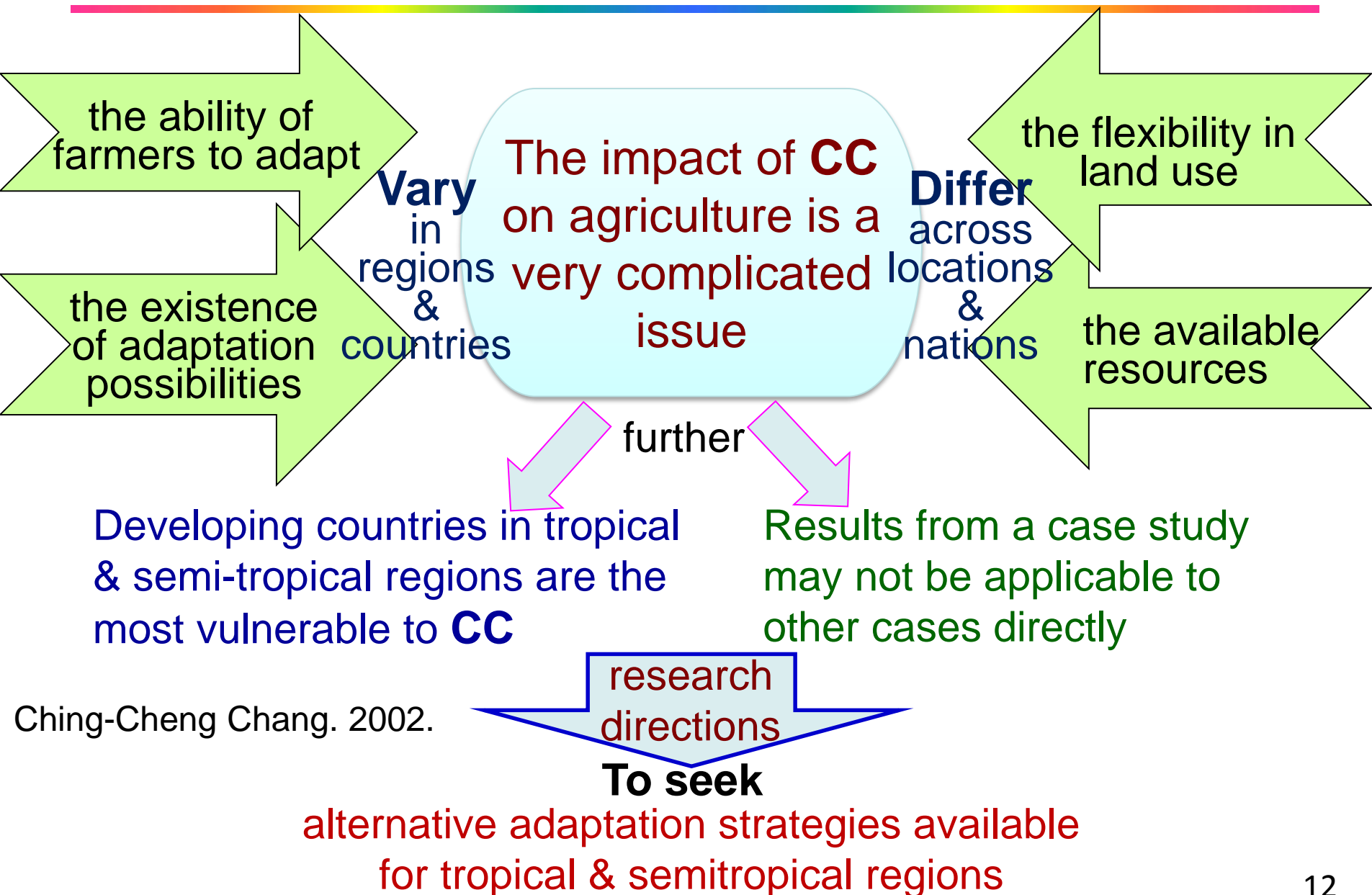
seeking ways to counteract/withstand the **adverse consequences of CC**

measures

- ✓. **switching** to more drought tolerant agricultural crops
- ✓. **managing** species that can adapt to climate change
- ✓. **Transforming** stressful effects into beneficial outputs by adaptive response
- . **increasing** conservation of protected areas
- . **maintaining** applicability of open spaces

.....

Impact of CC on Agriculture is Complicated

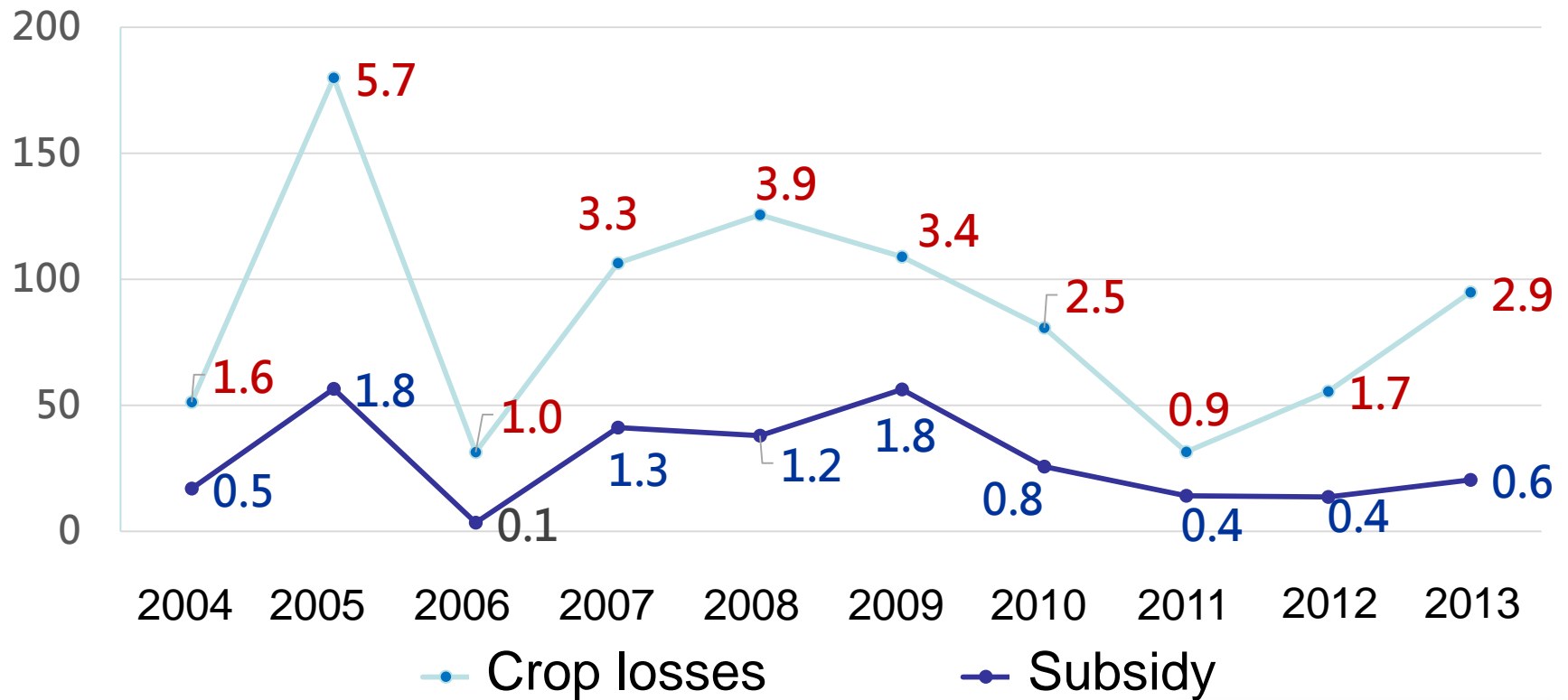


Ching-Cheng Chang. 2002.

Crops Losses by Climate Disasters in the Past Decade

in Taiwan

Unit : million USD



Economic losses by typhoons are the highest among natural hazards (USD 154 million/yr)



Climate Change Impacts on Crop Yields in Taiwan

in Taiwan

Warming & greater climate variability by **CC**

significant &
non-monotonic impact

depends on

↓ Yields of 60 crops in Taiwan

economic
approach of
adaptation
measures

- climate variation
- rainfall intensity
- Season
- growth stage

examples

shifts from traditional crops
to higher value-added crops

more production of
vegetables & specialty crops

To ensure

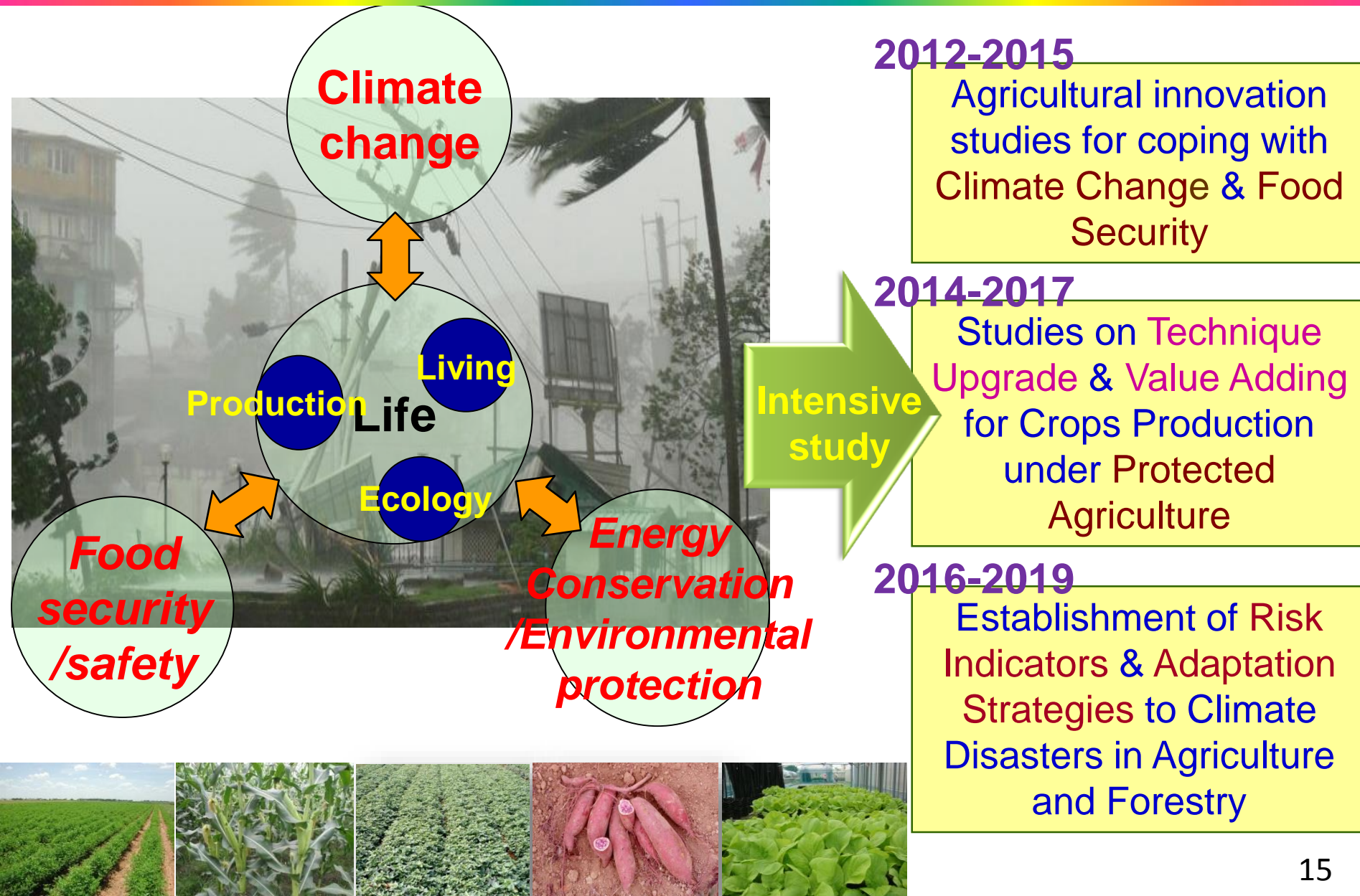
To maintain

Farmers' /producers' welfare

Regional food supply

Ching-Cheng Chang. 2002.
Agricultural Economics 27:51-64

Integrated Res. Projects to Cope with CC in Taiwan



Agricultural Innovation Studies for Coping with Climate Change and Food Security (2012-2015)

Goals

To develop **strategic measures** & **innovation technologies** that be adopted to not only **alleviate** impacts of climate change but **ensure** food security for Taiwan in the long run

Outputs

To help **ensuring** food security locally and **solving** the problems and challenges confronted by agricultural sector under climate change

Highlights

Adaptation strategies

Mitigation strategies

Agricultural production

Agribusiness opportunity

4 directions



Agricultural Innovation Studies for Coping with Climate Change and Food Security (2012-2015)

It responds to all aspects of society in demanding an intensive study on issues related to climate change and food security.

First phase

Strategy/ Theme I	<i>Food security responsive mechanisms & strategies</i>
Strategy/ Theme II	<i>Enhancement of stress tolerance in crops and livestock</i>
Strategy/ Theme III	<i>Eco-friendly cropping systems and indigenous vegetables utilization</i>
Strategy/ Theme IV	<i>Agricultural environment adaptation and management</i>
Strategy/ Theme V	<i>Energy conservation techniques and new energy sources for agriculture</i>
Strategy/ Theme VI	<i>International cooperation and collaboration</i>

Agricultural Innovation Studies for Coping with Climate Change and Food Security, 1st phase

Theme 1	Theme 2	Theme 3	Theme 4	Theme 5	Theme 6
Networking databases related to food security	Improving crop tolerance to abiotic stresses & its utilization	Integrating eco-friendly rotation systems for specific locations	Cultivation and nutrient management to reduce losses	Energy conservation efficiency for agricultural equipment	Introduction of germplasm, advanced technology and management system
Planning administrative policies for utilization and management of resources for food production	Exploiting new uses of local food crops varieties	Optimizing prevention and recovery techniques to stresses	Farming practice and crop/animal variety to reduce GHG emissions	Renewable energy in agricultural and food production	
Food safety risk management system and its responsive mechanisms	Scheming countermeasures for local unique wildlife to cope with climate change	Storage & transport methods to reduce losses of harvested produce	Soil carbon storage with improved crop and land management	Sensing devices & key elements for protected cultivation	International cooperation and collaboration
Matching and supporting measures for food self-sufficiency policies	Designing multiple feed ingredients, quality formulae and feeding systems for livestock	Framing and networking databases to rehabilitation of farming systems	Adaptive strategies for industry to deal with disasters & infrastructure	Techniques used for crops production under protected agriculture	Participation in international agricultural meetings and activities
		Utilizing indigenous vegetables	Early warning capability for oceanographic environment and offshore fishery resources		

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measures/subjects

Agricultural Innovation Studies for Coping with Climate Change and Food Security (2012-2015)

As a rolling project, strategies/themes of research are adjusted a little bit based on on their **feasibility** and **applicability**.

Second phase

Strategy/
Theme I

Food security responsive mechanisms & strategies

Strategy/
Theme II

Improving crop tolerance to stress and international cooperation ✓

Strategy/
Theme III

Eco-friendly cropping systems and indigenous vegetables utilization

Strategy/
Theme IV

Cropping systems for high yielding and high quality forage crops ✓

Strategy/
Theme V

Agricultural environment adaptation & practices to reduce losses from weather/climate disasters ✓

Strategy/
Theme VI

Energy conservation techniques & new energy sources for agriculture

Agricultural Innovation Studies for Coping with Climate Change and Food Security, 2nd phase

Theme 1	Theme 2	Theme 3	Theme 4	Theme 5	Theme 6
Collection of information for food security policy making	Screening and cultivation adjustment for stress tolerant rice varieties and international cooperation	Eco-friendly crop rotation systems to cope with climate change	Suitable forage crops and their cultivation techniques for import substitution	Disasters prevention and recovery techniques to reduce crop losses	Energy saving techniques and equipment development for agricultural production
Adaptation strategies for food production resources	Screening and cultivation adjustment for stress tolerant dryland crops	Knowledge-based environment and resources databases in response to climate change	Productivity improvement of corn varieties for animal feed	Infrastructure and resilience improvement to climate disasters for a better forecasting capability	Reutilization and recycling of agricultural waste for bettering ecofriendly functions of agricultural systems
Risk management and responsive mechanisms for food security	New uses of local rice varieties	Cultivation and utilization of indigenous vegetables	Diverse local materials and recipes for animal feed		
	Utilization of important economic crops & their adaptation measures				
	Insect pollination behavior and environmental indicators' animals				

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measures/subjects

Available Adaptation Strategies / Practices to CC for Rice Farming, **other rice research programs**

Factors of concern

Rainfall
Temperature
Sunlight/radiation
Variety
Management
Fertilizers
Pests & weeds.....

Germplasm approaches:

Change/alternate crops
Change rice varieties (selective varieties)
Crop diversification.....

Mitin, A. 2009.

Adaptation Strategies / Practices for rice farming



Institutional assistance:

Government assistance
International collaboration
Ag extension services.....

Farming systems:

Change cultivation area
Change farming type
Crop rotation
Agro-forestry.....

Watering techniques:

Systemize irrigation/drainage
Alternate wet and dry system
Aerobic cultivation.....

Cultivation techniques:

Improve cultivation techniques
Change planting/harvesting dates
Adjust inputs (fertilizers/pesticides)
Rice intensification.....

Concluding remarks, in general

- ※ The **vision** of agricultural research in Taiwan is to serve **farmers/agricultural sectors/general public** with their needs while advancing with new varieties, new technologies, and improved management so as to ensure **local sustainable agriculture development** into the future.
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- ※ The new varieties, new technologies, and improved management need to be '**transferred**' to **farmers / agricultural sectors** to build up and enhance their ability and capability doing farming activities as well as to cope with a **changing climate**.

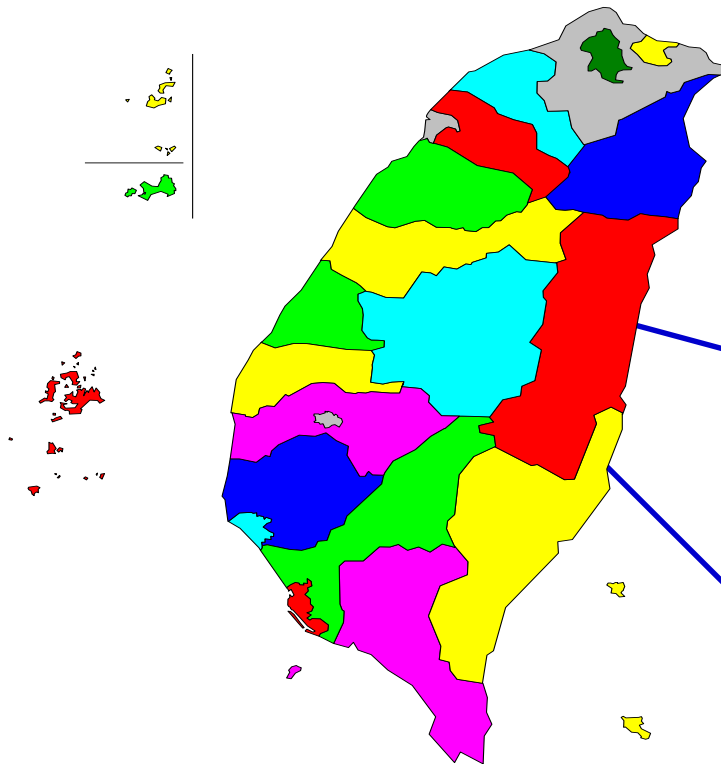


Concluding remarks, to climate change

- ⌘ As indicated in many studies, the ways to adapt or mitigate are **dynamic** & influenced by **mixed adverse conditions** bring up in combination of climate and non-climate events. Identify some **strategies** to reduce potential vulnerability, disclosure **changes** after applying options, and evaluate **outputs** from given inputs are crucial for an **integrated approach** to cope with climate change.
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- ⌘ **Diseases, pests and weeds** would undergo the same acceleration as cultivated crops and benefit from **carbonaceous fertilization** and **increased humidity** combined with **higher temperatures**. These are aspects need to be more vigorously explored in the future.





***Thank you
for your attention***