



Effects of Climate Change on Thailand's Agriculture and Food Security

Presented by

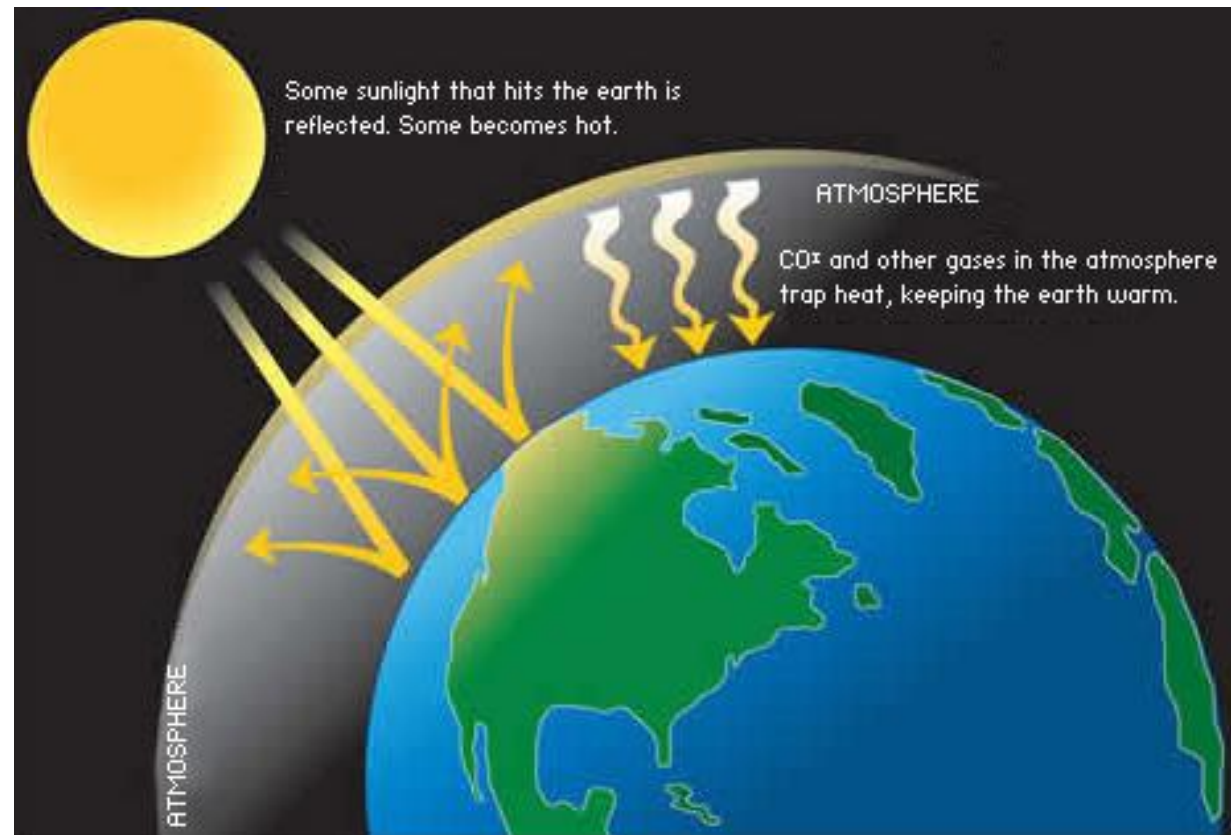
Witsanu Attavanich, Ph.D.

Assistant Professor, Faculty of Economics, Kasetsart University

witsanu.a@ku.ac.th

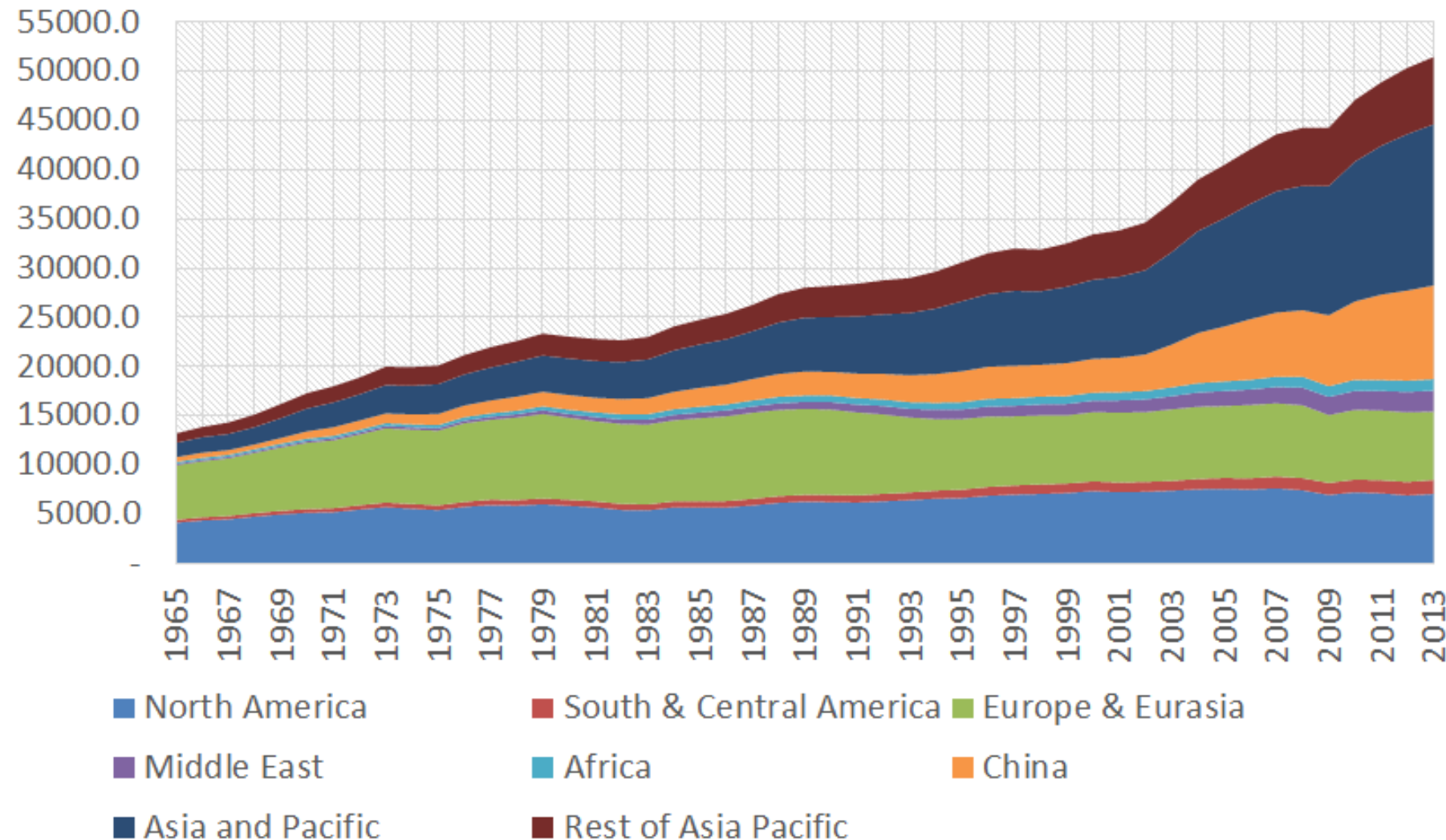
Greenhouse Effect

- Greenhouse gases absorb infrared radiation, trapping heat that would otherwise radiate into space.





Status of Greenhouse Gas Emission



Emissions of these gases increasing over time!

BP Statistical Review (2016)



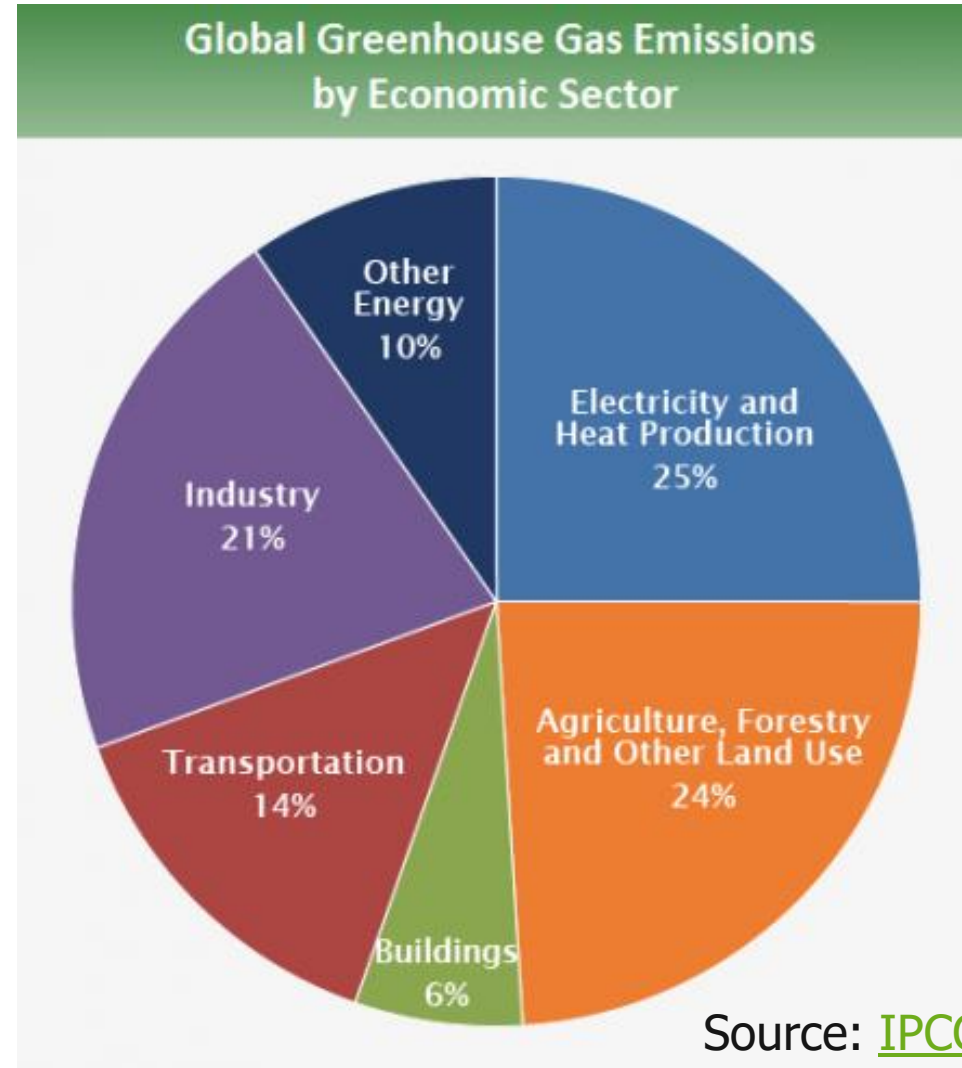
Status of Greenhouse Gas Emission



Source: http://cdiac.ornl.gov/trends/emis/tre_coun.html



Status of Greenhouse Gas Emission



Source: [IPCC \(2014\)](#)



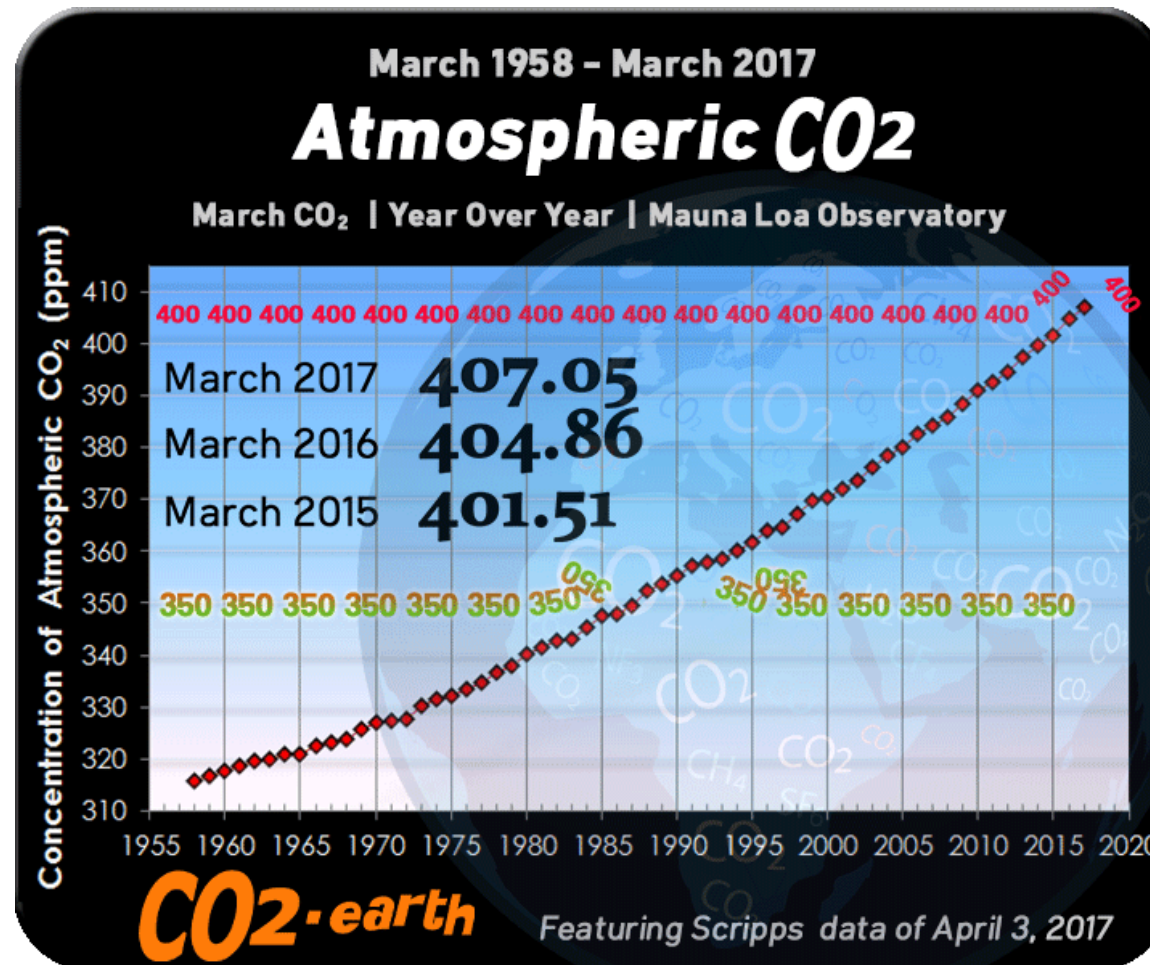
Status of Greenhouse Gas Emission



Approximately half of GHG emission has been released to the atmosphere!



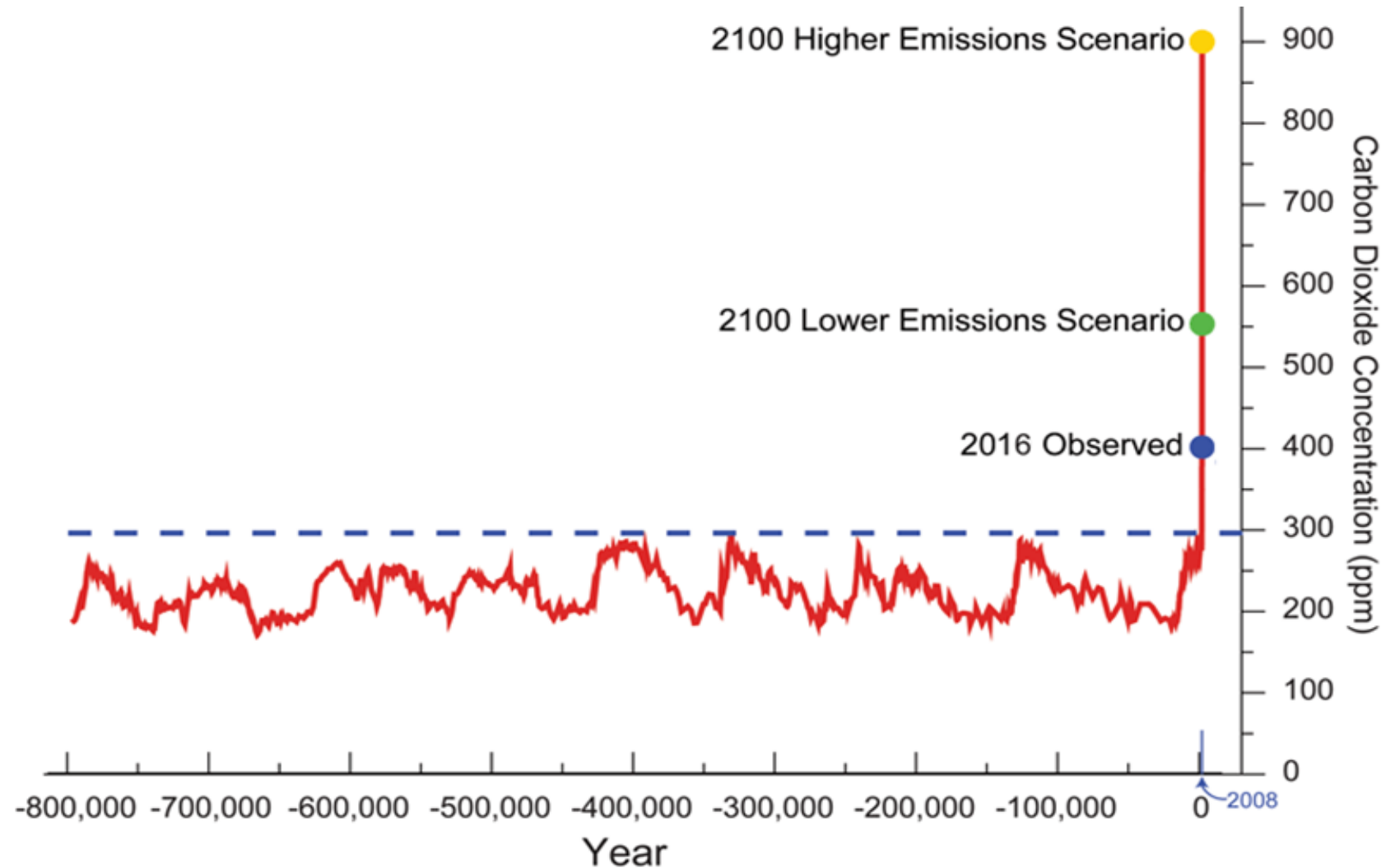
Status of Greenhouse Gas Emission



As a result, the atmospheric CO₂ concentration has increasing over time!



Status of Greenhouse Gas Emission



Current and expected atmospheric CO₂ concentrations exceed the historic levels !!!



Impacts may be bigger than the history of the mankind !!!



Dimensions of the Problem

- Human-induced warming and sea-level rise will continue for centuries, even if stabilized.

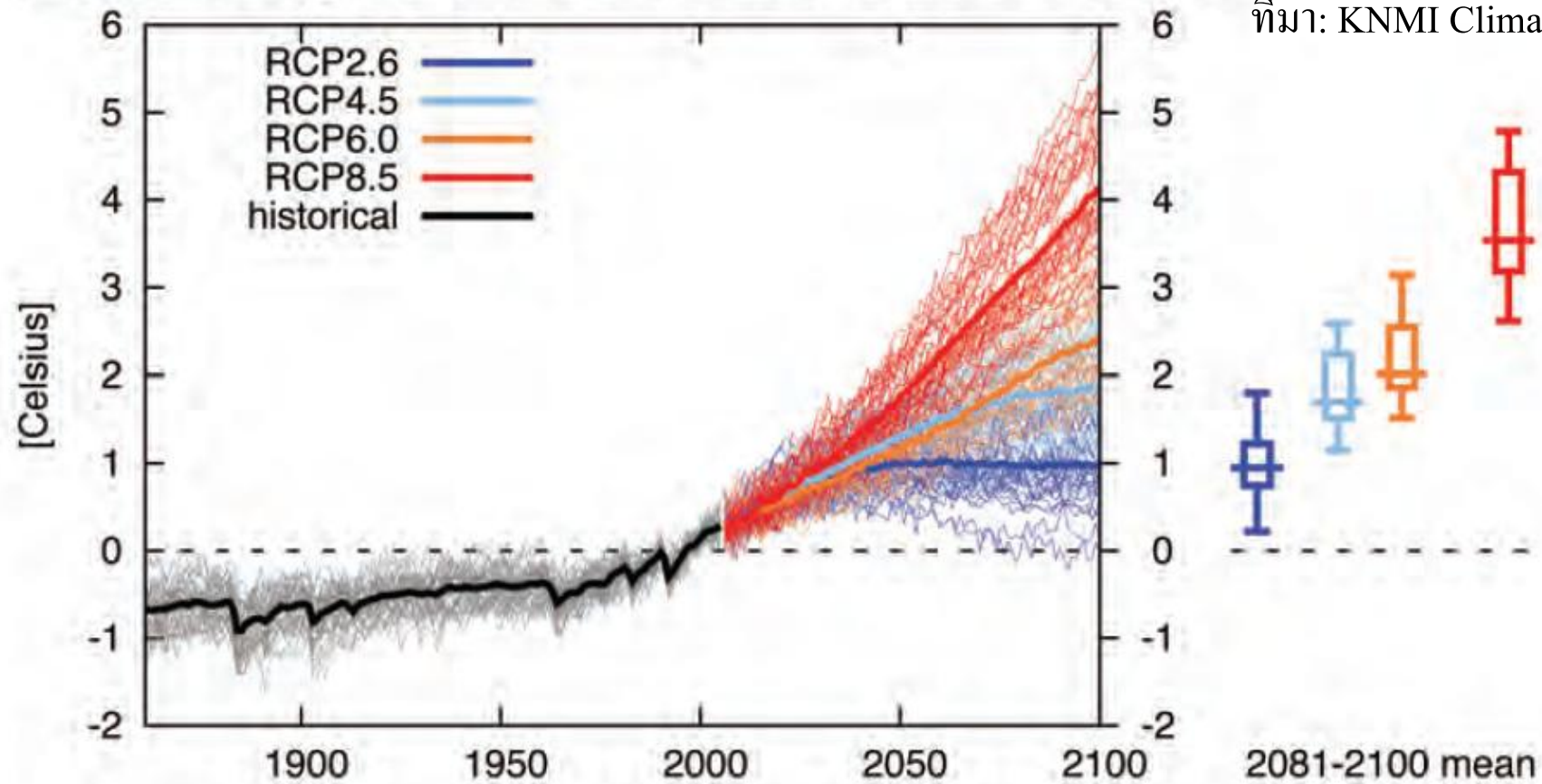
Greenhouse gas	Average lifetime in the atmosphere	Global warming potential of one molecule of the gas over 100 years (Relative to carbon dioxide=1)
Carbon dioxide	50-200 years*	1
Methane	12 years	21
Nitrous oxide	120 years	310
CFC-12	100 years	10,600
CFC-11	45 years	4,600
HFC-134a	14.6 years	1,300
Sulfur hexafluoride	3,200 years	23,900

Source: IPCC (2013)



Effects of Climate Change on Temperature

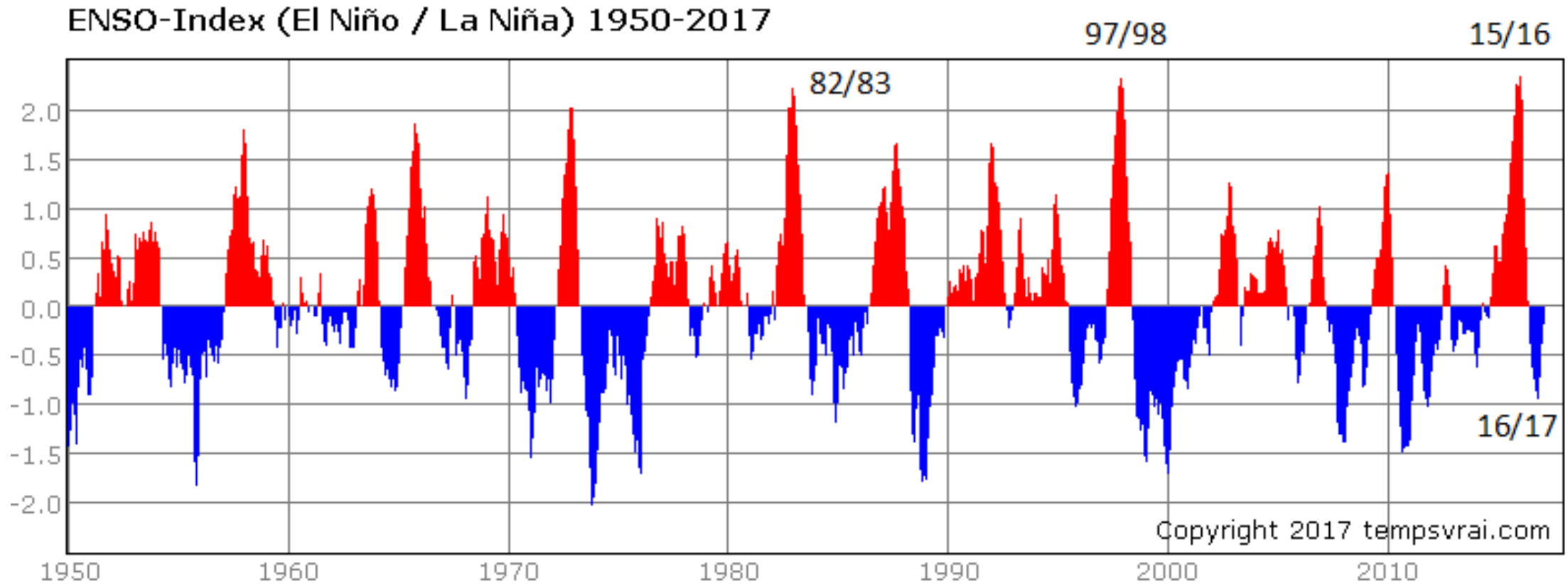
Temperature change World Jan-Dec wrt 1986-2005 full CMIP5 ensemble



Average global surface temperature is projected to increase 1 - 4 degree Celsius in 2100.



Effects of Climate Change on El Nino Phenomenon

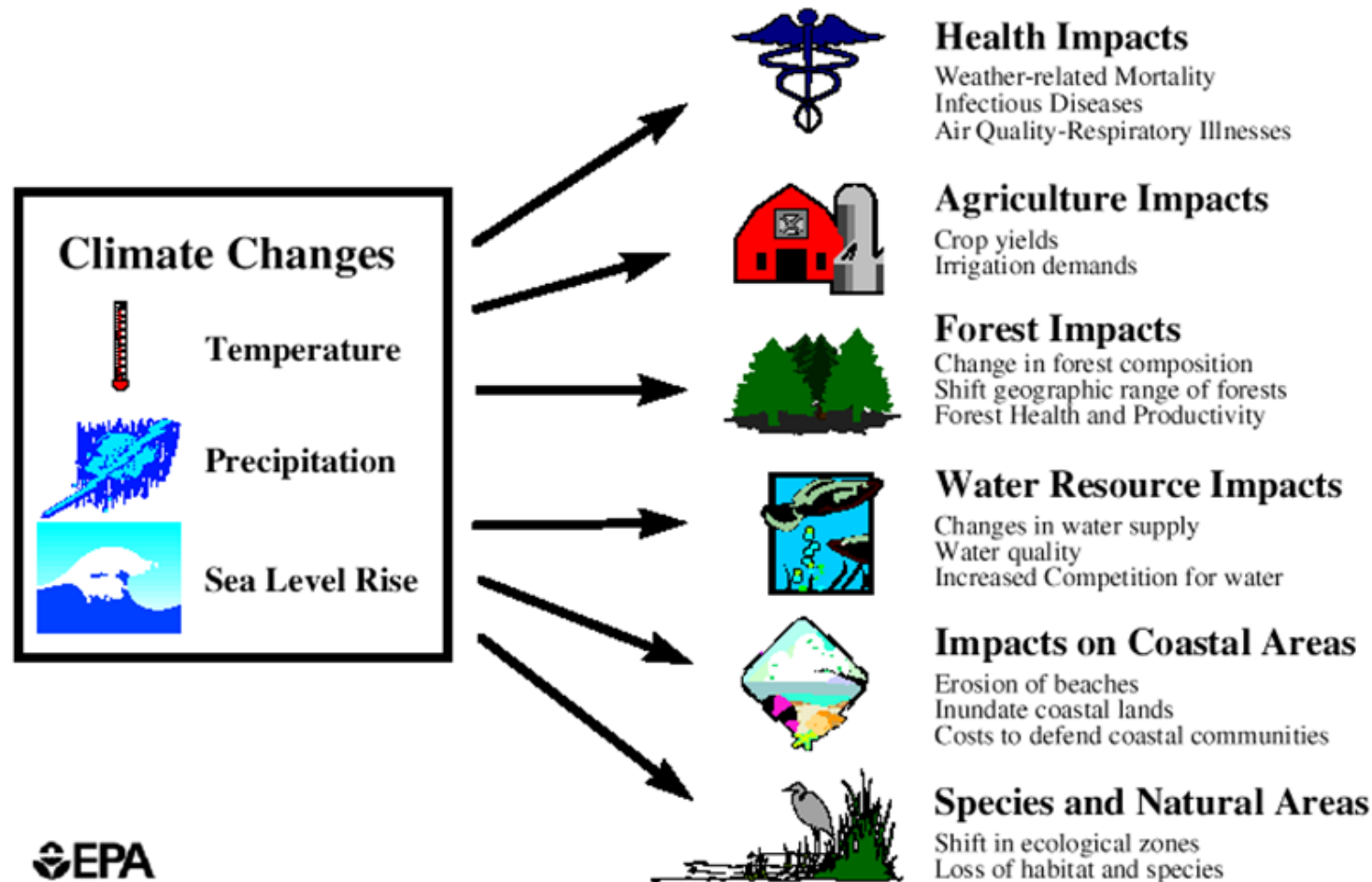


Source: NOAA (2017)

According to IPCC (2014), several models predicted that the usual El Niño phenomenon will likely change to extreme event.



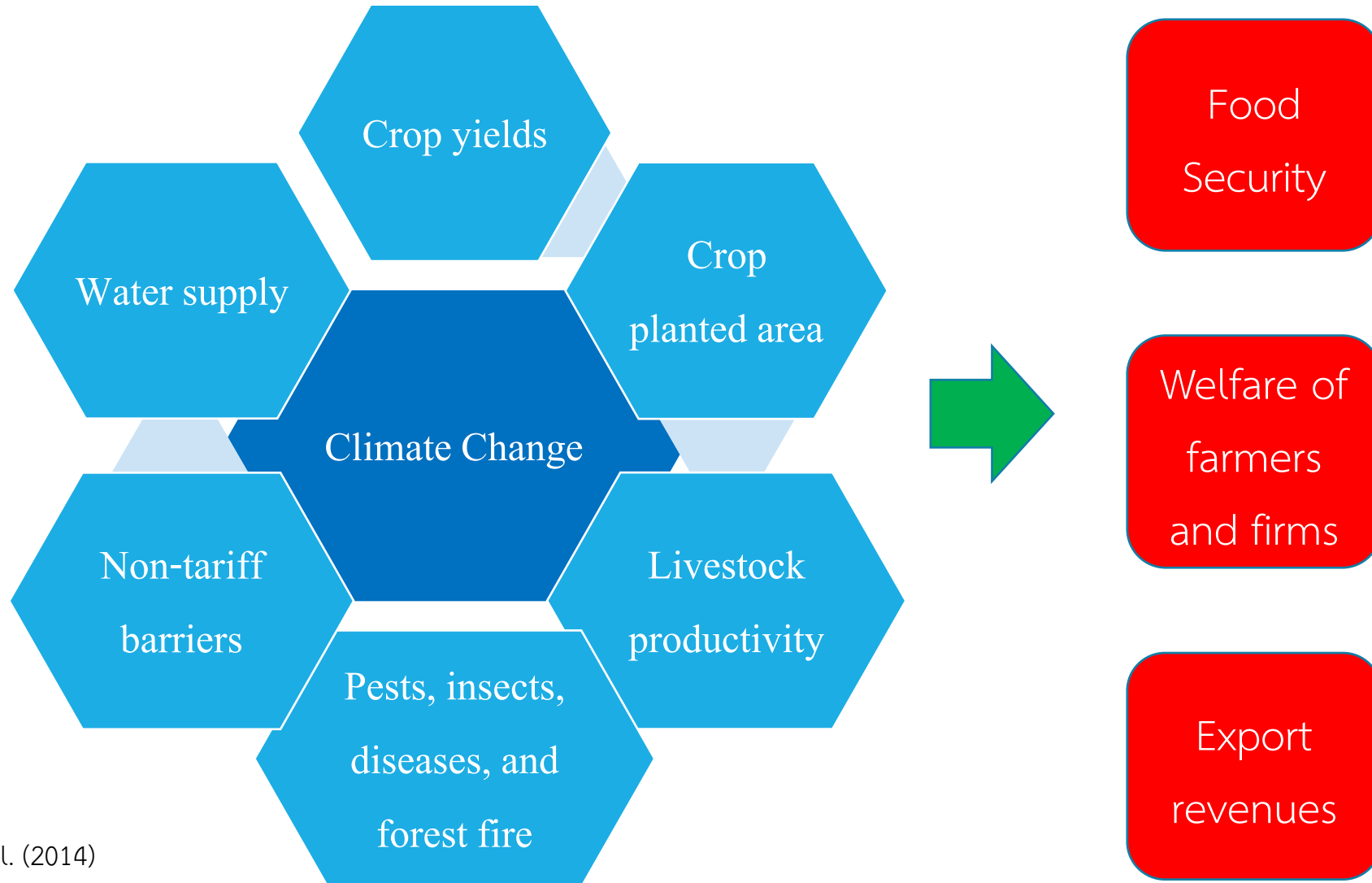
Overall Effects of Climate Change



United States Environmental Protection Agency



Effects of Climate Change on **Agriculture**



Source: McCarl et al. (2014)



Effects of Climate Change on **Food Security**



Food security exists when all people, at all times, have **physical, economic and social access** to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

(UN-FAO World Food Summit 1996, 2012)

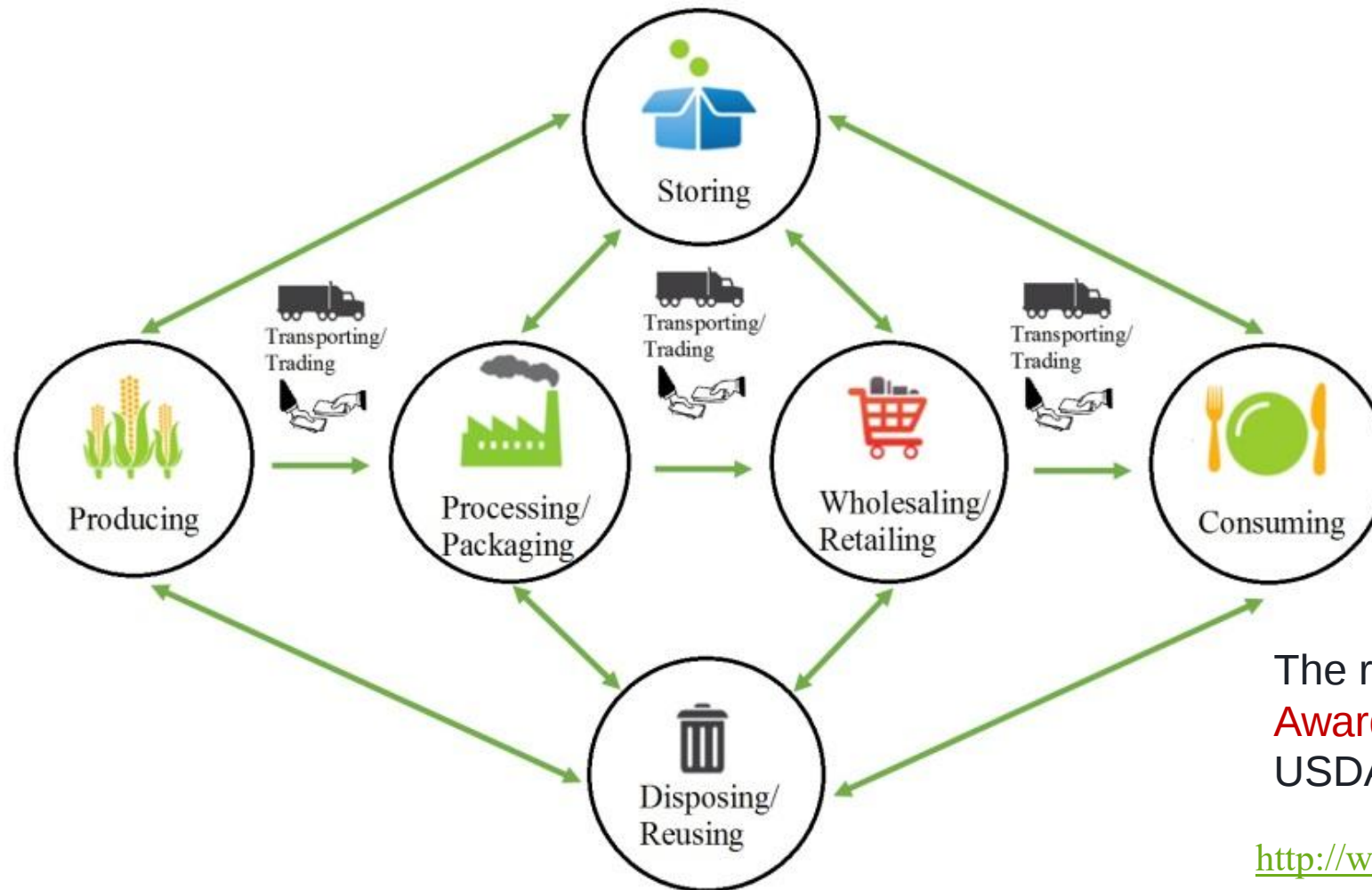


... is universally applicable
... is more than food production
... is underpinned by food systems



Effects of Climate Change on Food Security

Food Systems include a set of 'Activities' ...



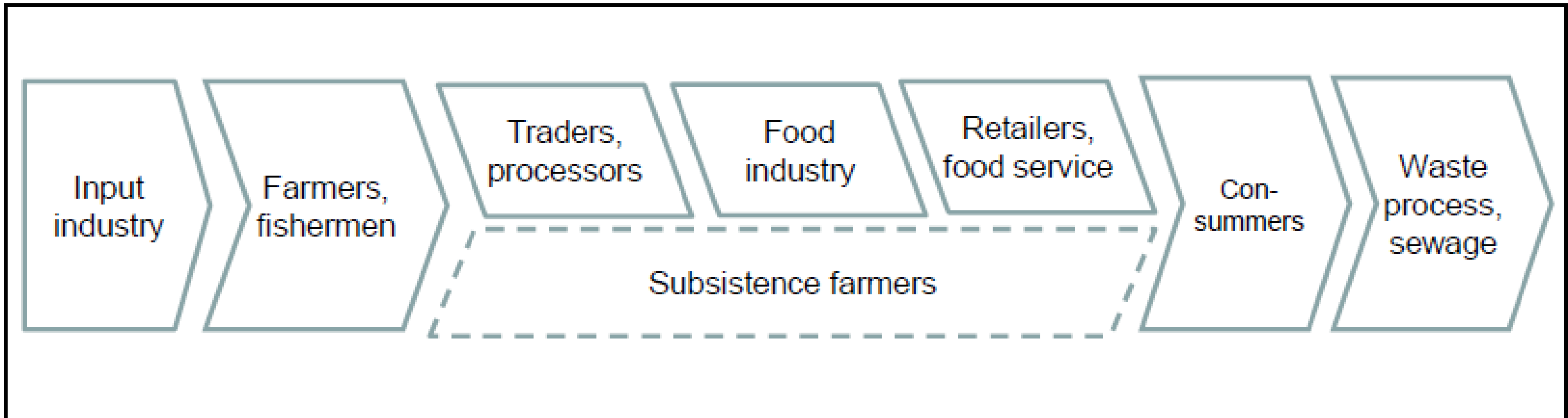
Brown, M.E., J.M. Antle, P. Backlund, E.R. Carr, W.E. Easterling, M.K. Walsh, C. Ammann, **W. Attavanich**, C.B. Barrett, M.F. Bellemare, V. Dancheck, C. Funk, K. Grace, J.S.I. Ingram, H. Jiang, H. Maletta, T. Mata, A. Murray, M. Ngugi, D. Ojima, B. O'Neill, and C. Tebaldi. 2015. **Climate Change, Global Food Security, and the U.S. Food System**. 146 pages. Available online at http://www.usda.gov/oce/climate_change/FoodSecurity2015Assessment/FullAssessment.pdf

The report won the **2016 Abraham Lincoln Honor Award for Increasing Global Food Security** from the USDA.



Effects of Climate Change on **Food Security**

... all of which have a wide range of Actors ...



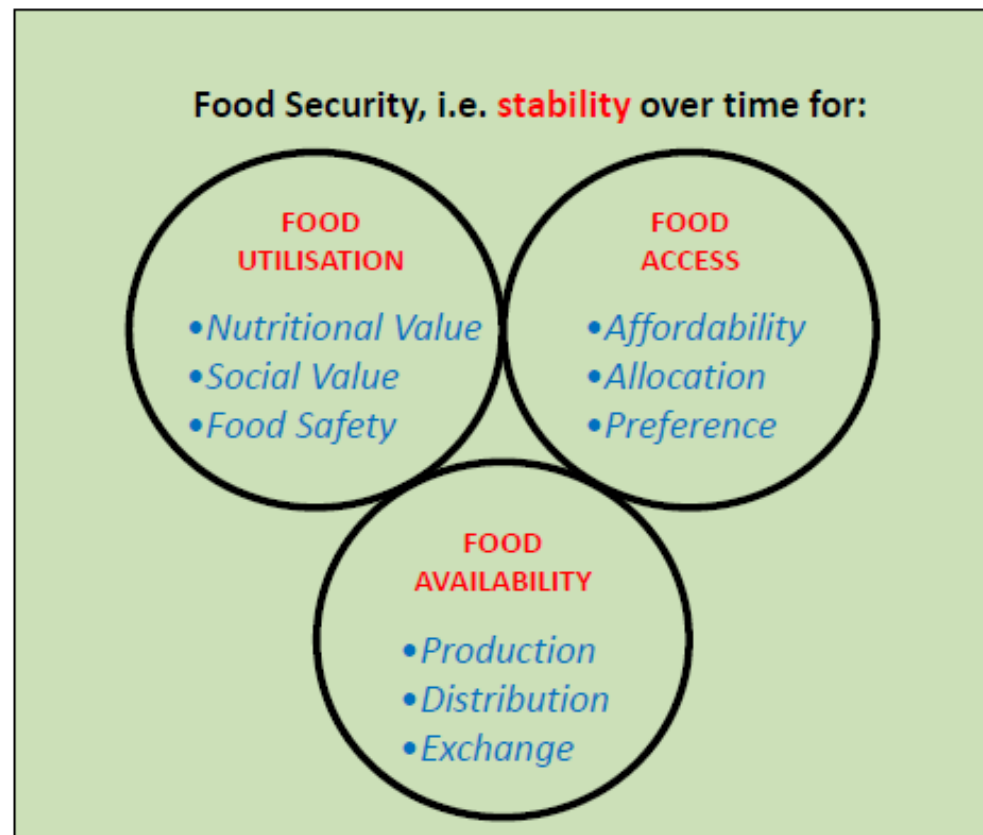
... all of whom have a range of motives ...



Effects of Climate Change on **Food Security**

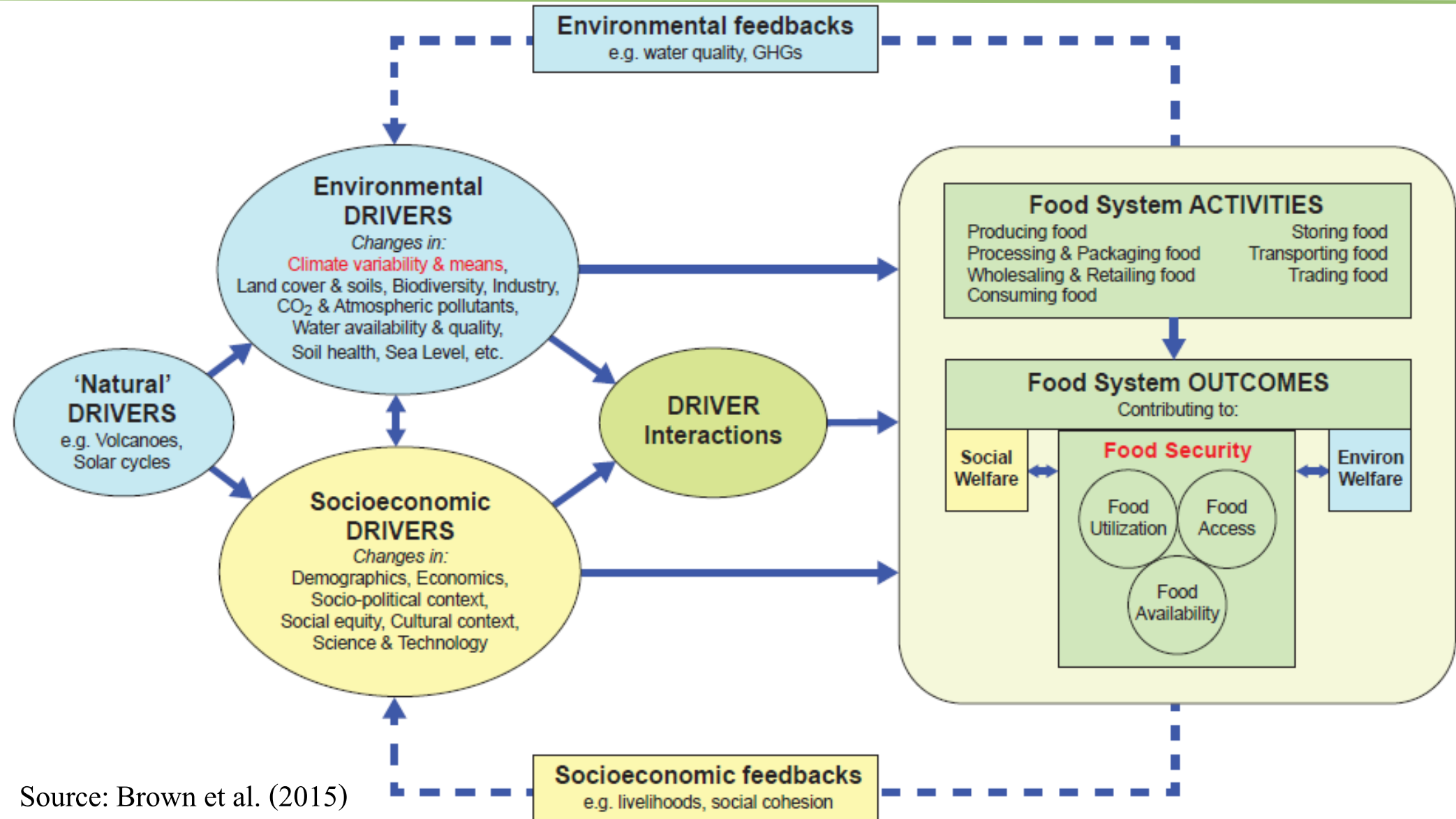
- Food System Activities underpin food security 'Outcomes'

“... exists when all people, at all times, have **physical, economic and social access** to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life.”





Effects of Climate Change on **Food Security**



Source: Brown et al. (2015)



Effects of Climate Change on **Food Security**

Food Availability and Stability

- Changes in climate may diminish rates of yield growth by up to 2.5% per decade, globally (Porter et al. 2014)
- Crops grown in warmer climates are at greater risk of exceeding temperature thresholds as temperatures rise (Gourdji et al. 2013, Teixeira et al. 2013)
- Packaging, processing, and storage specifications are sensitive to temperature and humidity, and therefore also likely to be influenced
- Transportation systems that support trade are subject to climate disruptions as well as limiting the ability for production deficits in one location to be compensated by production excesses elsewhere



Effects of Climate Change on Food Security

Relative risks to key food availability elements for different SSPs

Shared Socioeconomic Pathway	Production		Storing/Processing/ Packaging		Trade		Transport	
	P	W	P	W	P	W	P	W
SSP1								
SSP2								
SSP3								
SSP4								
SSP5								

(P: poorer nations, W: wealthier nations)

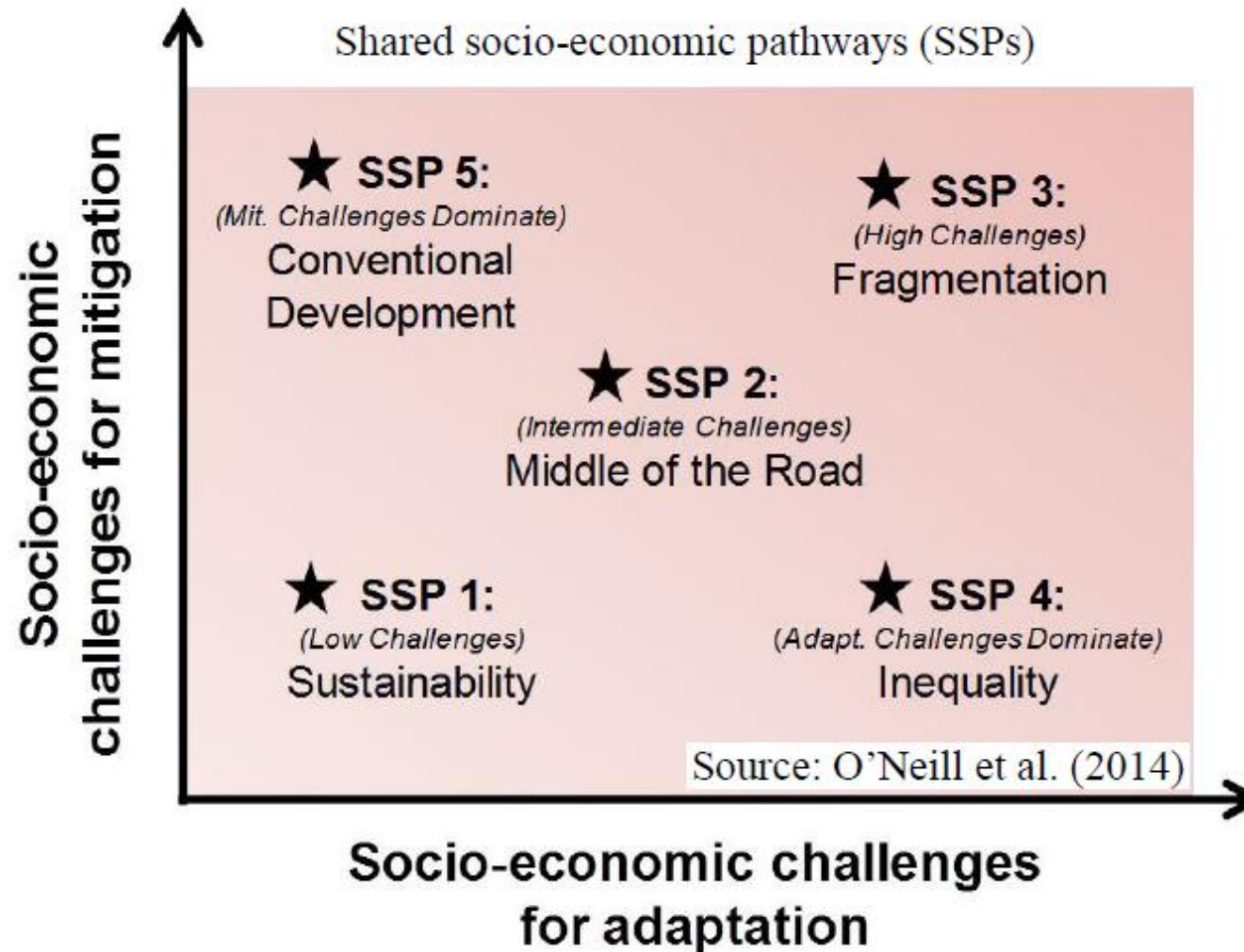
Risks would be lowest under the economic conditions described by SSP1 and SSP5, with poorer nations at higher risk.

Key
Low Risk
Medium/Low Risk
Medium Risk
High Risk
Very High Risk

Source: Brown et al. (2015)



Effects of Climate Change on Food Security





Effects of Climate Change on **Food Security**

Food Access and Stability

- Price affects food affordability, which integrates food prices with income for purchasing food.
- Trade in agricultural commodities and food can reduce price volatility and enhance stability for both producers and consumers by enabling areas of food production surpluses to supply areas of deficit.
- Extreme temperatures, heavy rainfall events, drought, sea-level rise, and storm surge can damage road, rail, and shipping infrastructure.

Source: Brown et al. (2017)

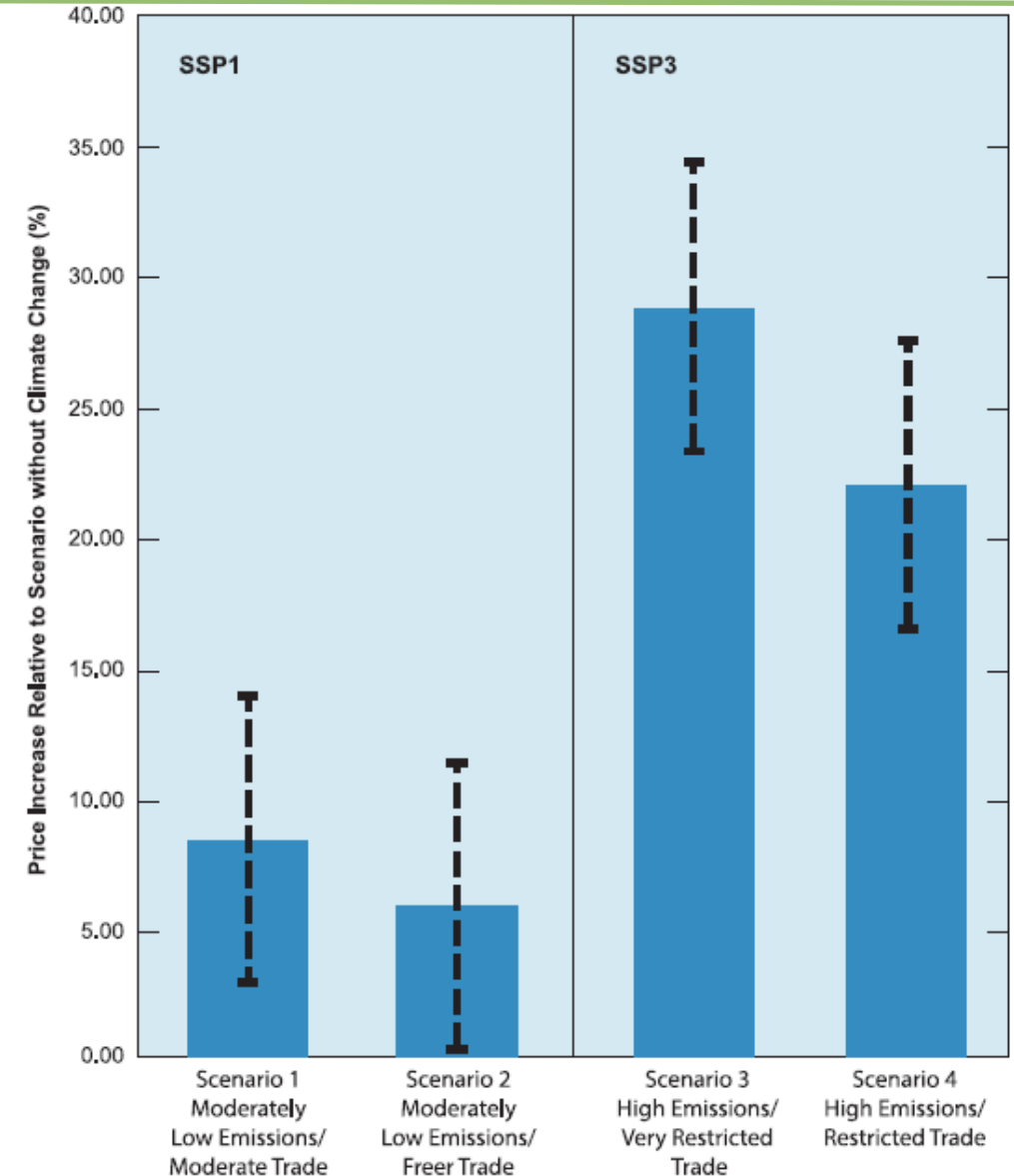


Effects of Climate Change on **Food Security**

Projected mean food price changes in 2050

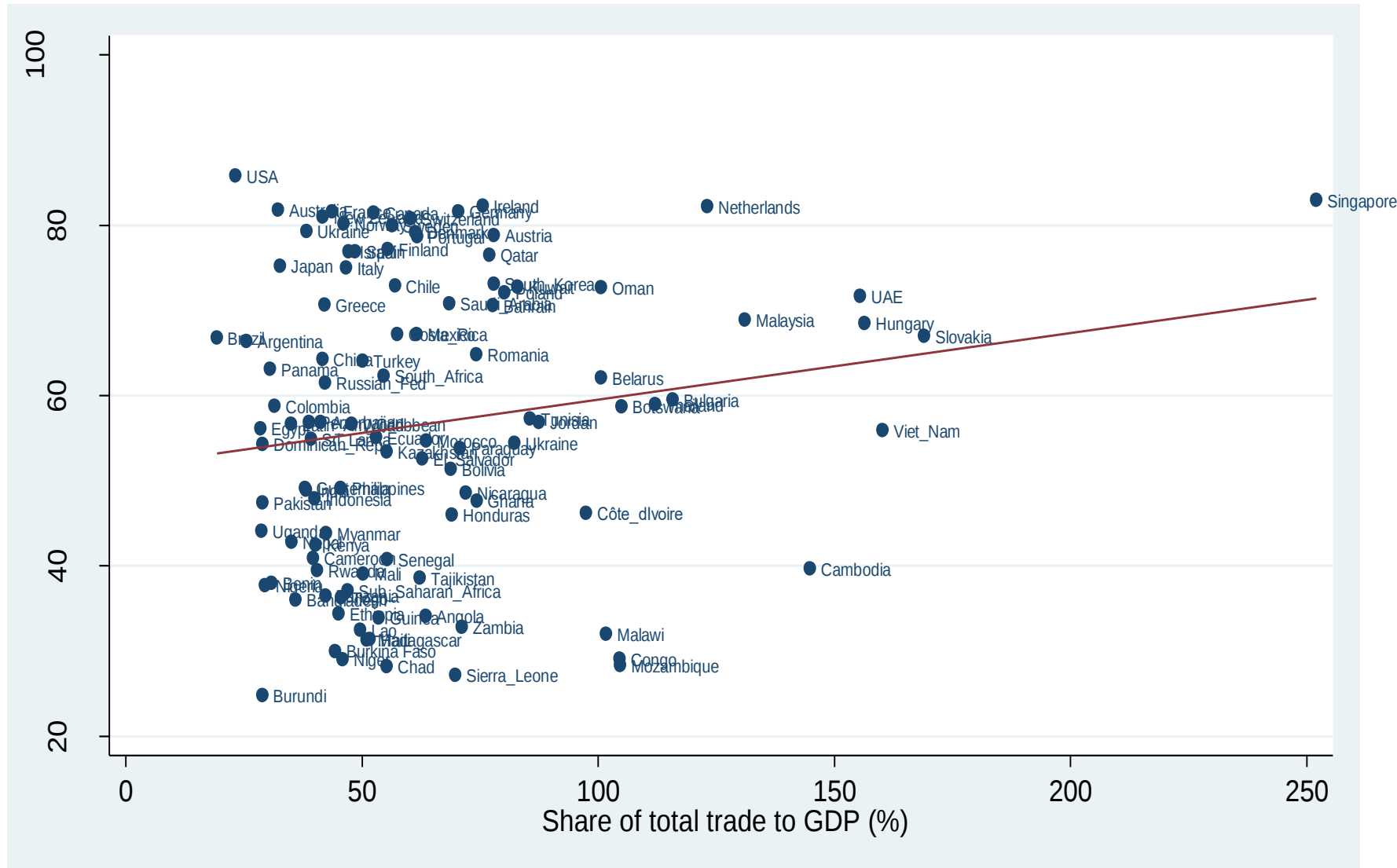
All scenarios demonstrate increased prices under climate change.

Freer trade results in smaller projected price increases for both low emissions (Scenario 2) and high emissions (4) scenarios.





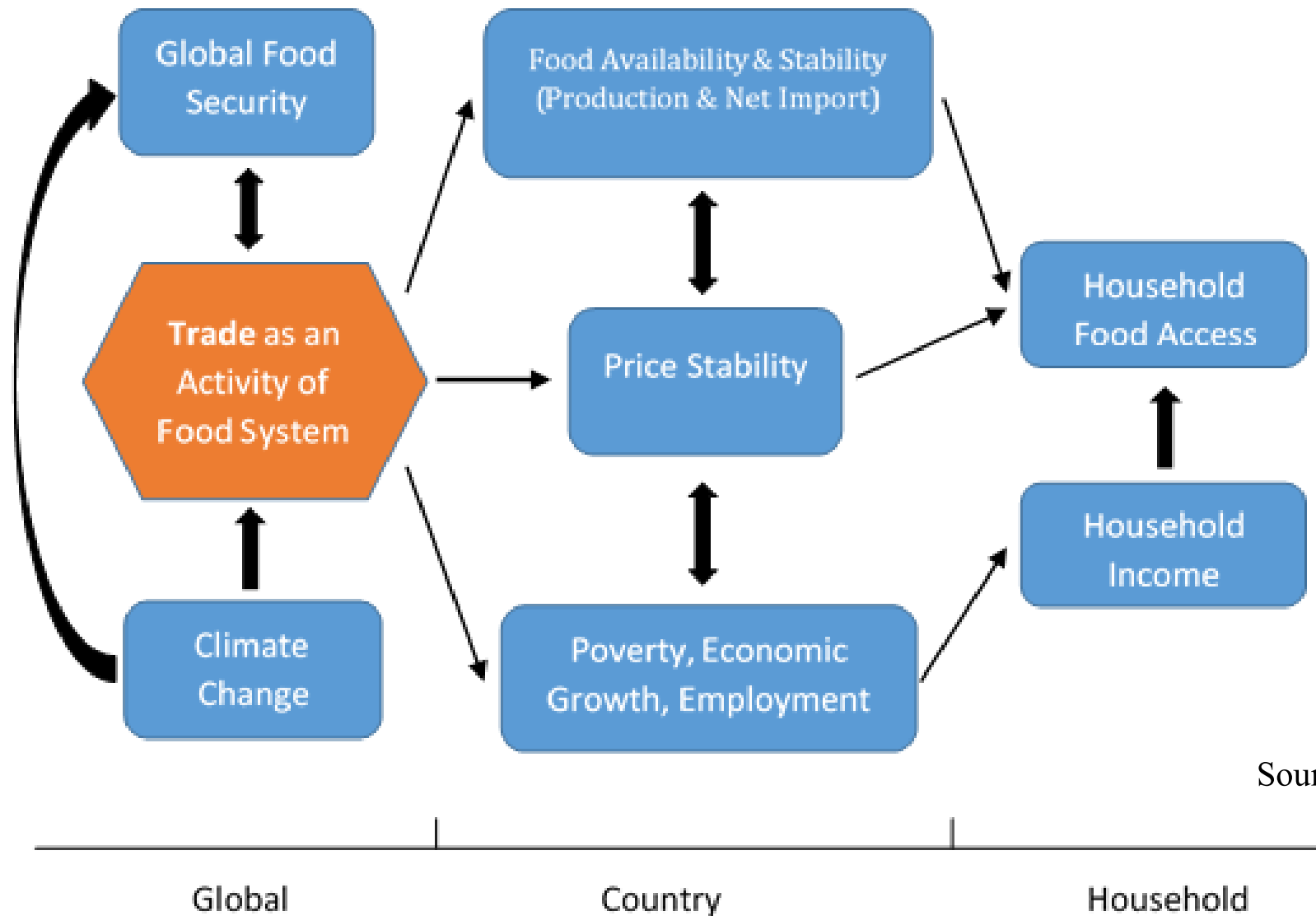
Effects of Climate Change on Food Security



Source: Calculated from
EIU, The Economists
and COMTRADE
Database



Effects of Climate Change on **Food Security**



Source: Brown et al. (2017)



Effects of Climate Change on Food Security

Relative risks to key food access elements for different SSPs

Shared Socioeconomic Pathway	Price	
	P	W
SSP1		
SSP2		
SSP3		
SSP4		
SSP5		

Key
Low Risk
Medium/Low Risk
Medium Risk
High Risk
Very High Risk

(P: poorer nations, W: wealthier nations)

Risks would be lowest under the economic conditions described by SSP1 and SSP5, with poorer nations at higher risk *across almost all food affordability and allocation categories for all SSPs.*

Source: Brown et al. (2015)



Effects of Climate Change on Food Security

Food Utilization and Stability

- Influences on food utilization—food safety and nutrition; food processing, packaging, and storage; and food consumption and disposal—are likely to be increasingly challenged by changing climatic conditions.
- Fruit and vegetable crops harvested with higher pulp temperatures require more energy for proper cooling (Moretti et al. 2010).
- Higher temperatures and humidity generally cause increased mycotoxin accumulation.
- More-frequent food pathogen and contaminant monitoring may also be indicated in a changing climate (Gregory et al. 2009).



Effects of Climate Change on Food Security

Relative risks to key food utilization elements for different SSPs

Shared Socioeconomic Pathway	Food Safety		Health Status		Key
	P	W	P	W	
SSP1					Low Risk
SSP2					Medium/Low Risk
SSP3					Medium Risk
SSP4					High Risk
SSP5					Very High Risk

(P: poorer nations, W: wealthier nations)

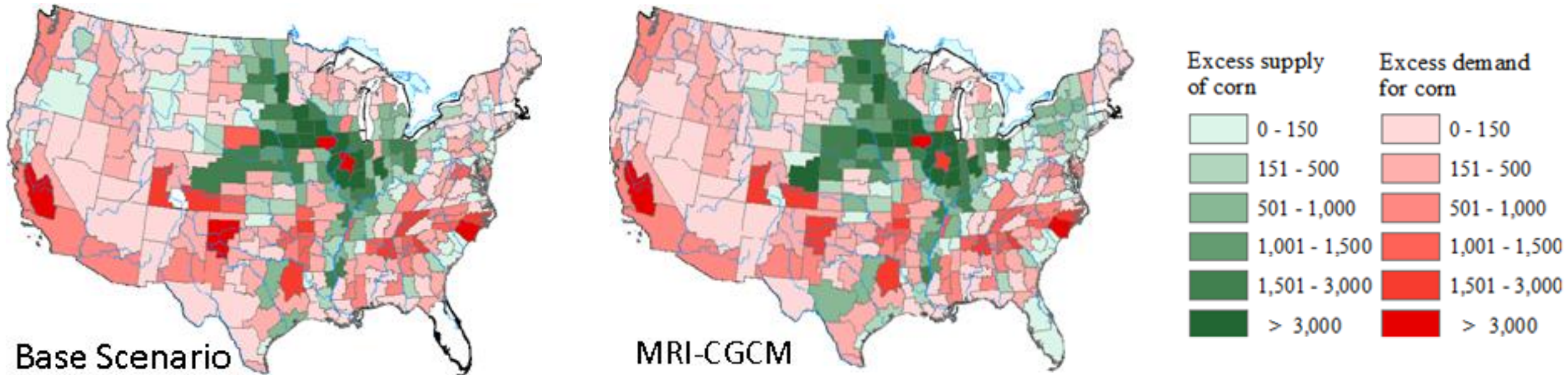
Source: Brown et al. (2015)

Risks would be lowest under the economic conditions described by SSP1 and SSP5, with poorer nations at higher risk *across all food utilization categories for all SSPs*.



Climate Change Impacts on the US Grain Transport

Effect of Climate Change on Shifts in Crop Production Patterns in the US (Corn from 2007 to 2050)

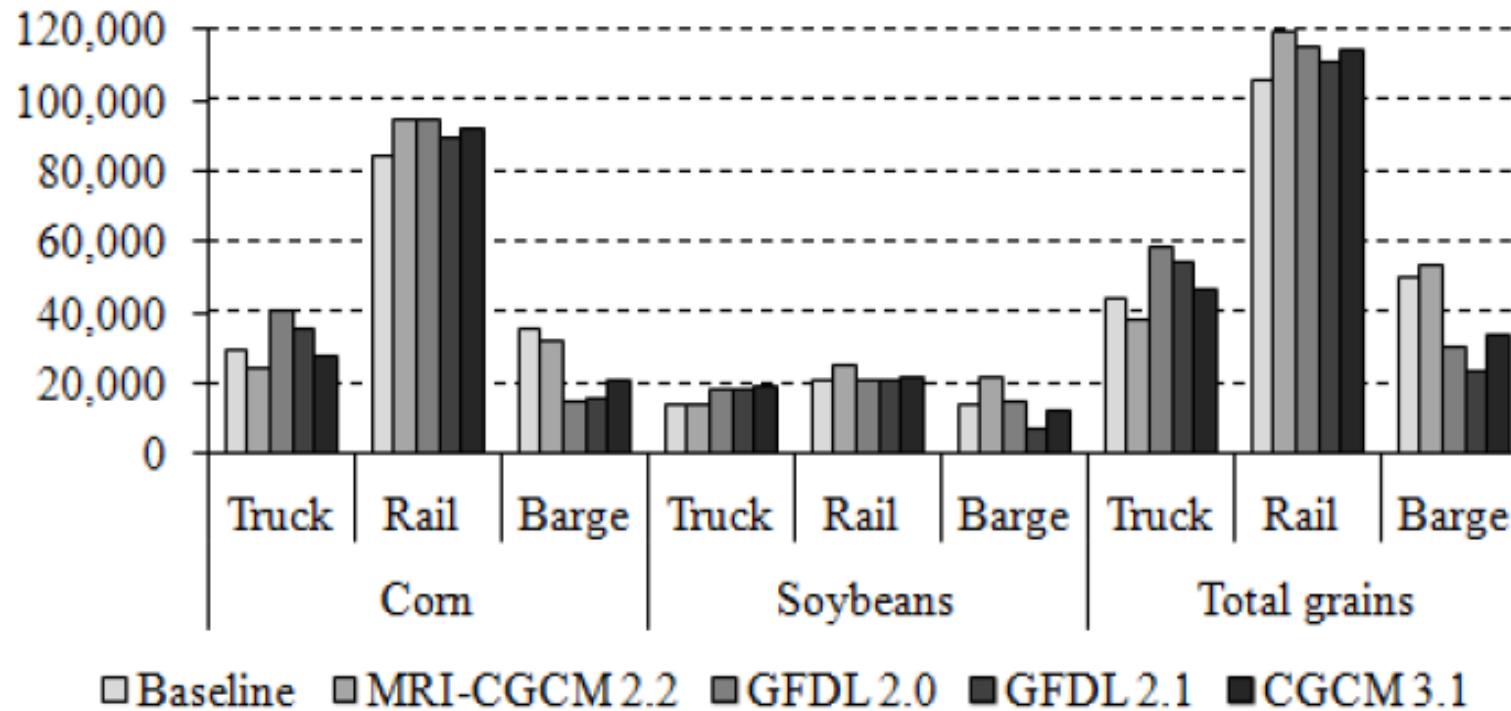


Note northward shifts in excess supply plus southern/central excess demand

Source: Attavanich, W. et al. 2013. "Effects of Climate Change on US Grain Transport." *Nature Climate Change* 3:638–643.



Climate Change Impacts on the US Grain Transport



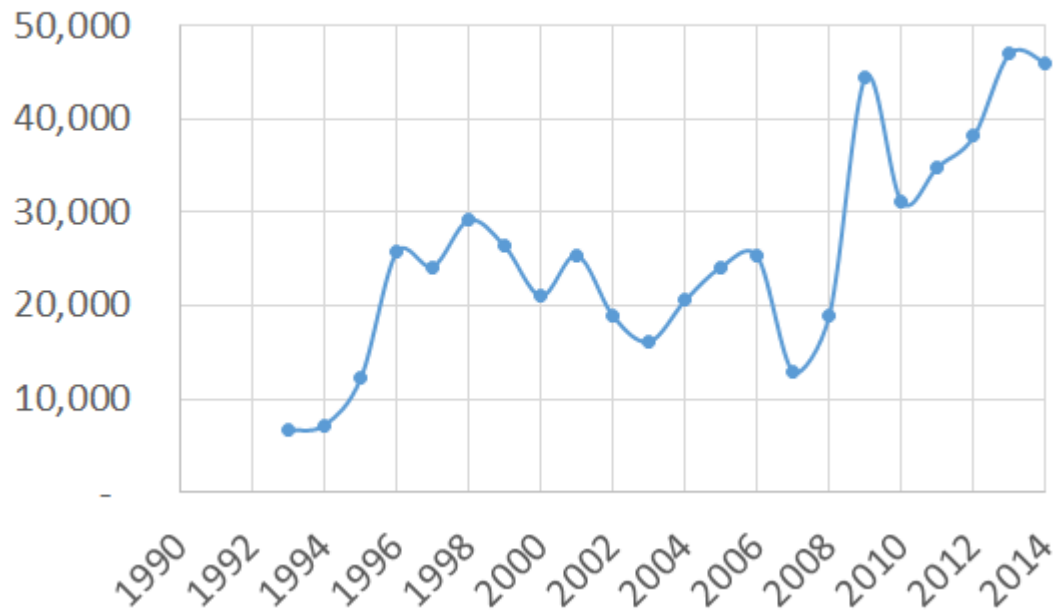
Demand for barge is projected to decrease,
while demands for rail and truck are projected to increase.

Source: Attavanich, W. et al. 2013. “Effects of Climate Change on US Grain Transport.” *Nature Climate Change* 3:638–643.



Climate Change Impacts from Drought in Thailand

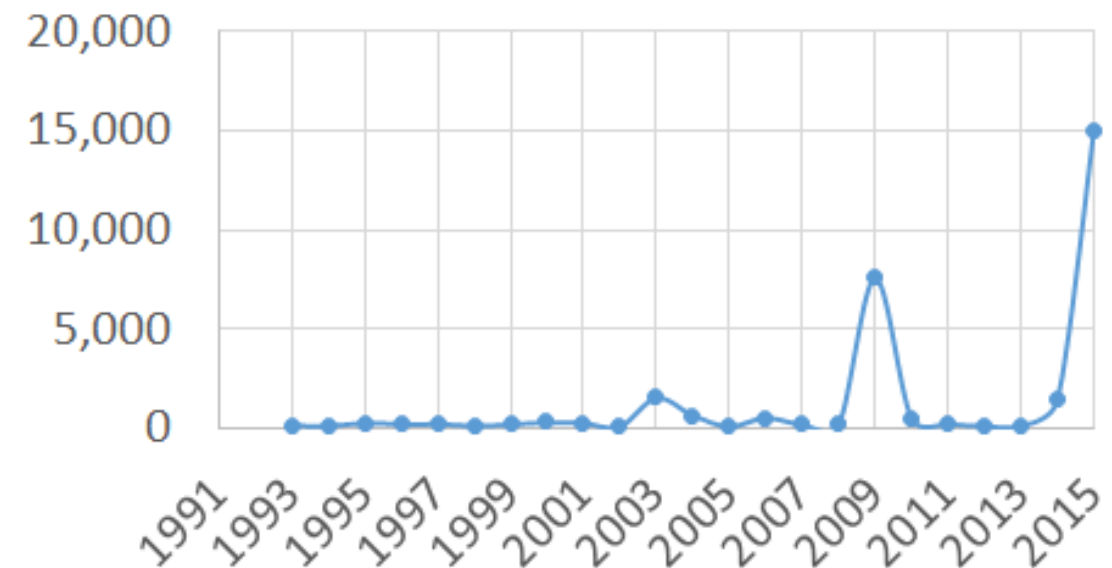
Number of Affected Villages



Source: Department of Disaster Prevention and Mitigation

Value of the damage
from drought tends to
increase overtime!

Value of the Damage from Drought

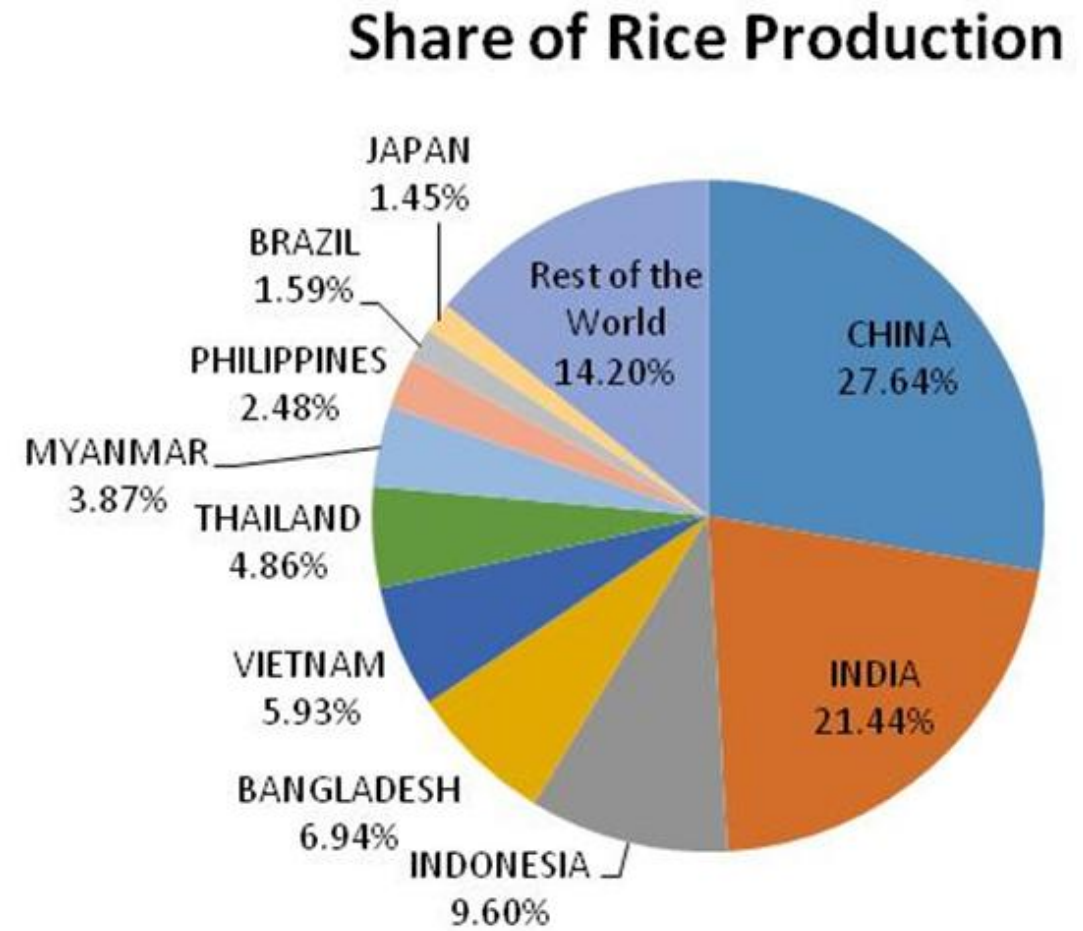




Climate Change Impacts on Global Rice Production

Country	Production (1,000 tons)
CHINA	205,207
INDIA	159,200
INDONESIA	71,280
BANGLADESH	51,500
VIETNAM	44,039
THAILAND	36,063
MYANMAR	28,767
PHILIPPINES	18,439
BRAZIL	11,783
JAPAN	10,758
Rest of the World	105,459
Total	742,494

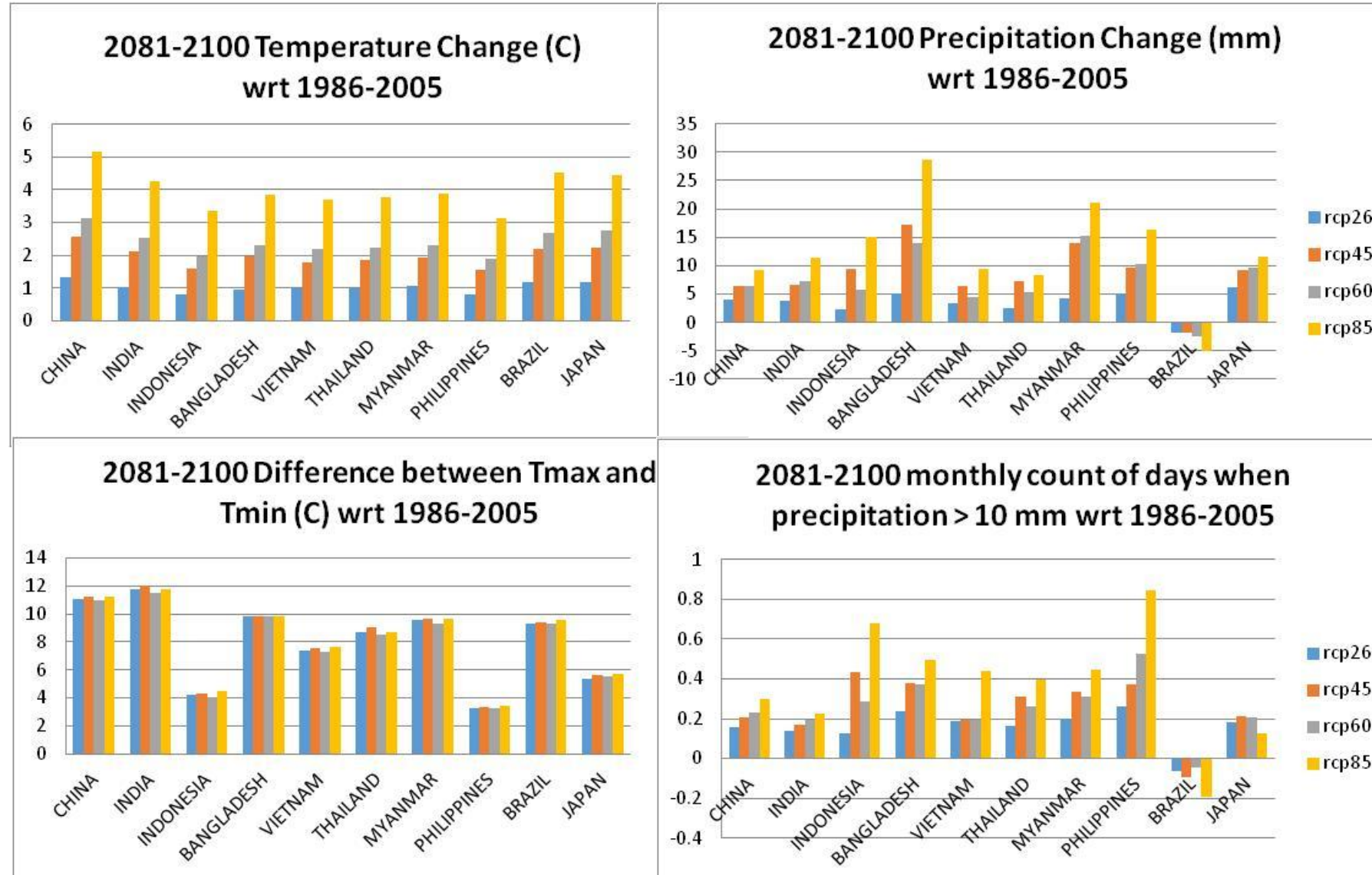
Source: Attavanich (2016)



Source: FAO (2015)



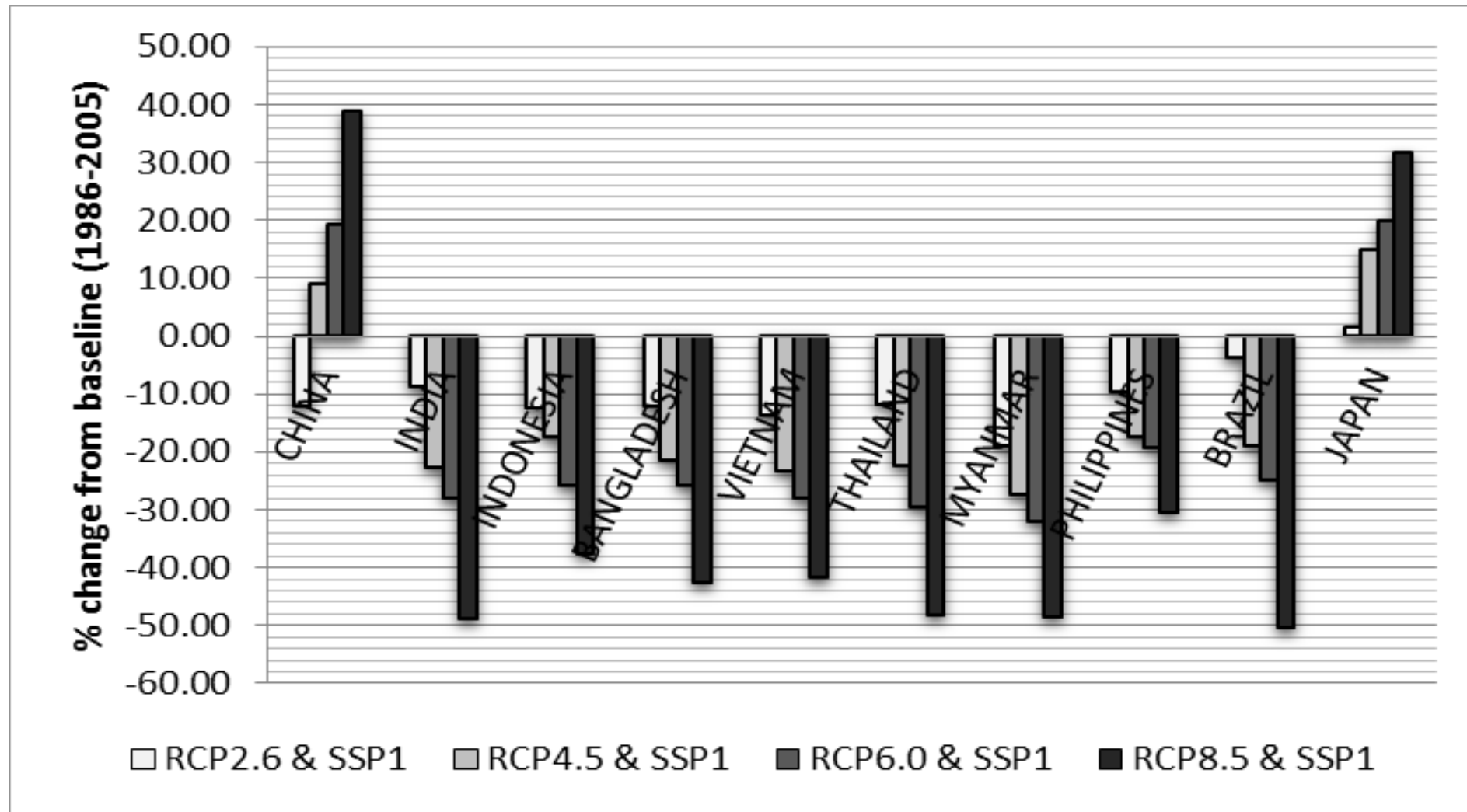
Climate Change Impacts on Global Rice Production





Climate Change Impacts on Global Rice Production

Projected Impact on Rice Yield during 2090-2100





Climate Change Impacts on Global Rice Production

Projected Impact on Rice Yield in Thailand during 2090-2100

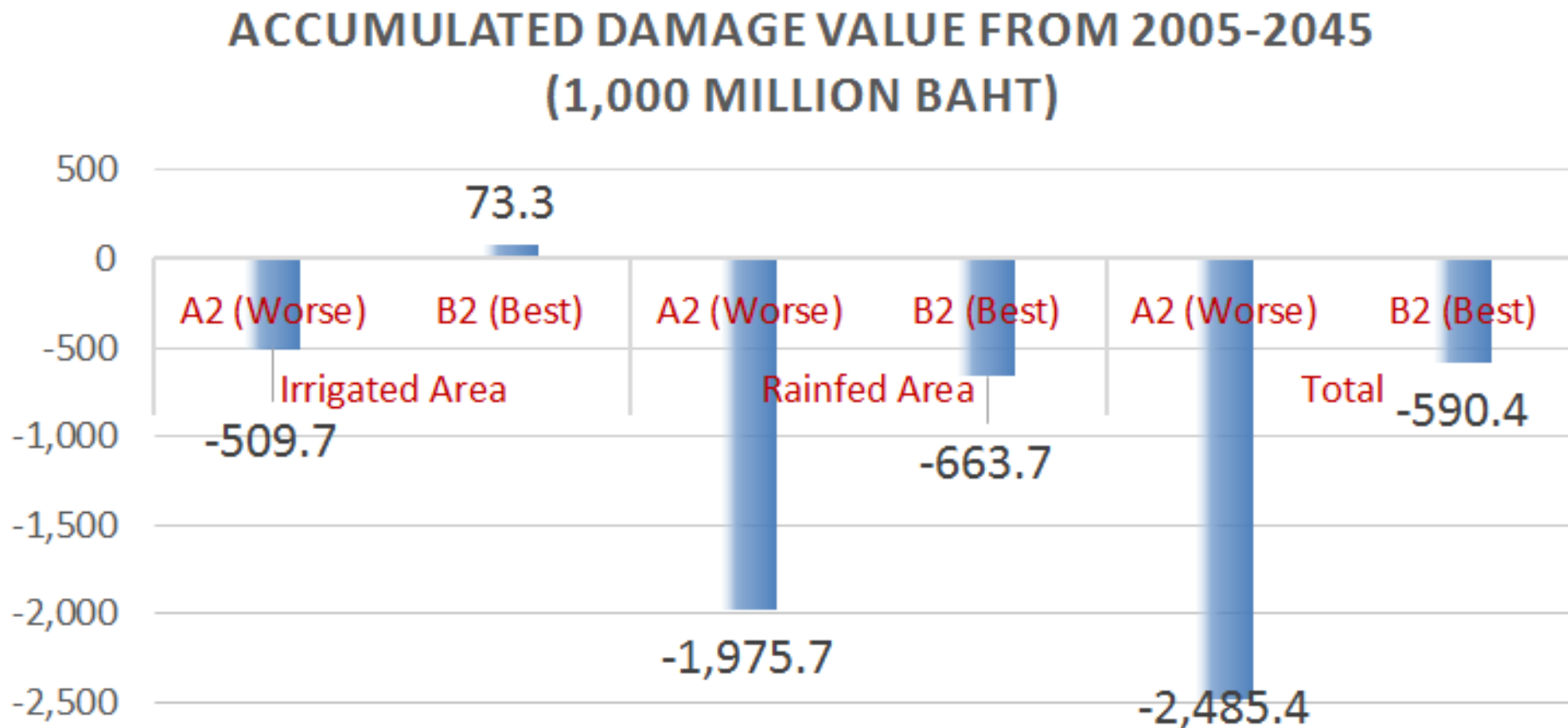
Scenarios	Percent Change from the Baseline (1985-2005)			
	RCP2.6	RCP4.5	RCP6.0	RCP8.5
SSP1	4.76	-7.78	-16.16	-38.38
SSP2	0.12	-11.87	-19.87	-41.12
SSP3	-11.8	-22.35	-29.41	-48.12
SSP4	-5.7	-16.99	-24.53	-44.54
SSP5	7.7	-5.19	-13.81	-36.66
No SSP	-9.3	-20.16	-27.41	-36.1

Rice yield in
Thailand is
projected to drop
in almost all cases

Source: Attavanich (2016)



Climate Change Impacts on Thailand's Agriculture



Projected impacts did not cover damages from food system activities other than production!



Climate Change Impacts on Thailand's Agriculture



“The bigger impact for now will be felt in rural communities. Thai economist Witsanu Attavanich estimates the drought would cost the country 62 billion baht (S\$2.4 billion) in damage.”

Source: <http://www.straitstimes.com/asia/drought-exacts-toll-on-crops-in-region>



Adaptation Strategies: Autonomous adaptation

Farmers (Rice, Corn, Rubber Tree, Cassava, Oil Palm, Livestock)

- select the rice cultivar that can tolerate the heat stress
- use the organic fertilizers to capture soil moisture
- Improve water management by digging the small pond to store water
- apply the springer water system
- adjust the planting dates and planted cover crops to store the soil moisture and improve soil nutrients
- apply evaporative cooling system to control temperature in the barn



Adaptation Strategies: Autonomous adaptation

Private Sector

- reduce the cost of production
- create additional income from byproducts of agricultural production
 - planted the Napier grass to substitute for the animal food
 - sold the carbon credit,
 - used waste from agricultural production to generate the renewable energy
- attempt to find the new planted area to avoid the pest and insect (coconut)
- provide the knowledge to the farmers so that the firms can have the stability of the raw materials
- do research with academic institutes



Policy Recommendations

- To obtain practical adaptation strategies and mitigate the risks, climate change impact studies are needed for all crops and livestock and the analysis should cover all food system activities with the participation from all parties
- To encourage the appropriate adaptation, public relations may be implemented to all stakeholders to create their understanding and recognition on climate change impacts
- To enhance the knowledge for adaptation, public relations to convey innovations, technologies, and local wisdom should be continually implemented
- To reduce the damage, enhancing the development of early warning system should be prevalently implemented



Policy Recommendations

- Supporting the agglomeration of small farmers to receive the useful information, improve their bargaining power, and reduce costs of production
- Research studies to measure the capacity of the current crop cultivars under climate change may be important
- Setting up the committees responsible for monitoring, forecasting, and preventing the potential measures on trade and investment barriers may be needed
- Developing the central database to convey the technological and innovative knowledge for climate change may be needed



Policy Recommendations

- Government should raise the importance of potential climate change problems as the major priority
 - Climate change projects usually are not be included in the normal work plan for the governmental organizations → No direct budgets
- Integration of all government organizations to solve the climate change problems may be needed



THANK YOU

Contact Information:

Asst. Prof. Witsanu Attavanich, Ph.D.

Department of Economics, Faculty of Economics, Kasetsart University

50 Phahonyothin Rd., Chatuchak,

Bangkok, Thailand, 10900

witsanu.a@ku.ac.th

<https://sites.google.com/site/attavanichw/>