2011 CTPECC Agricultural and Food Policy Forum:
Moving Beyond Market Volatility to Foster Food Security

Climate Risk and Information Technology Development for Agri-Food Systems

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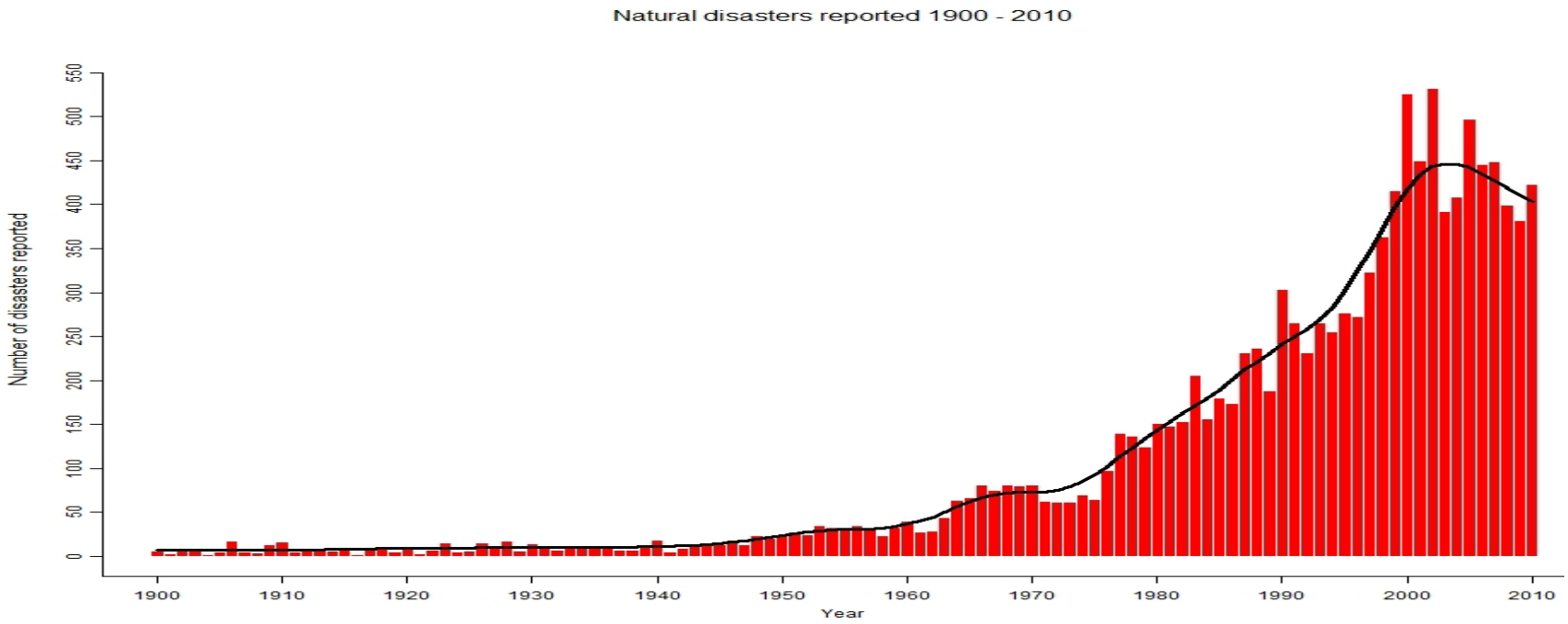
Outline

- Natural Disasters Trends
- Impacts of Monsoon
- Impact of ENSO
- Warming Climate and Fishery Sector
- Sea Level Rise(SLR) and Rice Production
- Space Information Technology Development
- Conclusion

Background

- Natural hazards may well increase in both frequency and intensity under projected climate change and their impacts enhanced because of anthropogenic activities.
- Agricultural sector is highly vulnerable to climate change and climate variability.



Source: EM-DAT: The OFDA/CRED International Disaster Database.

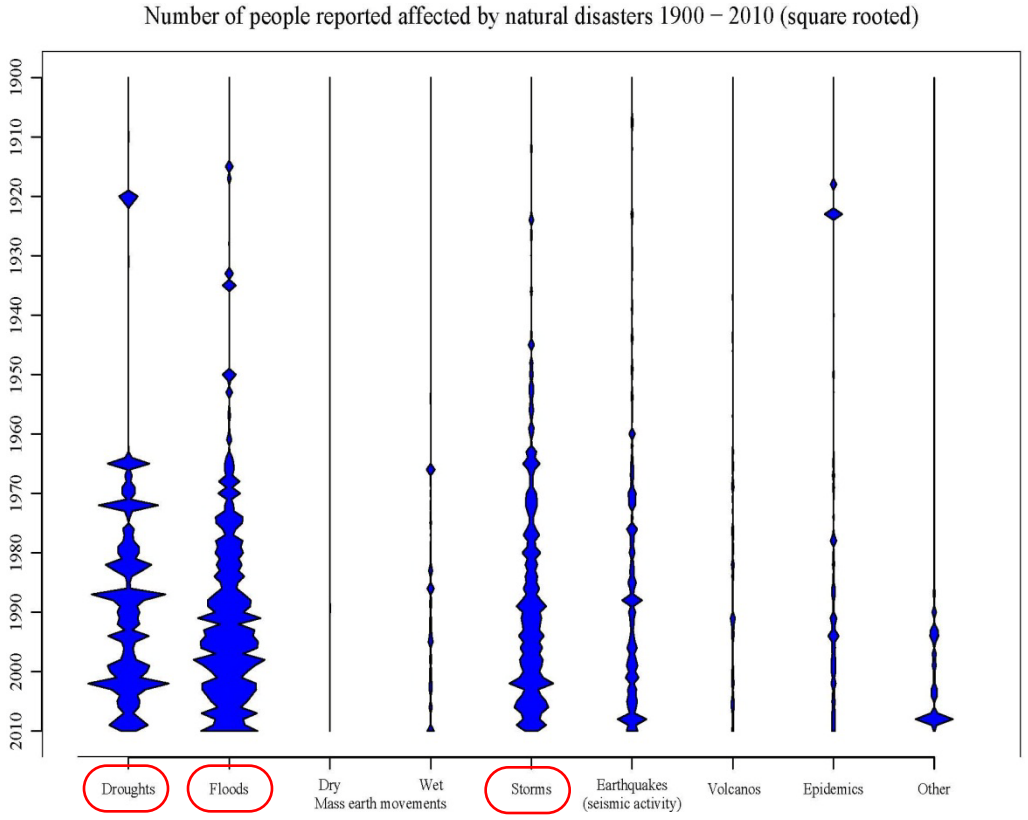
Number of people affected by natural disasters

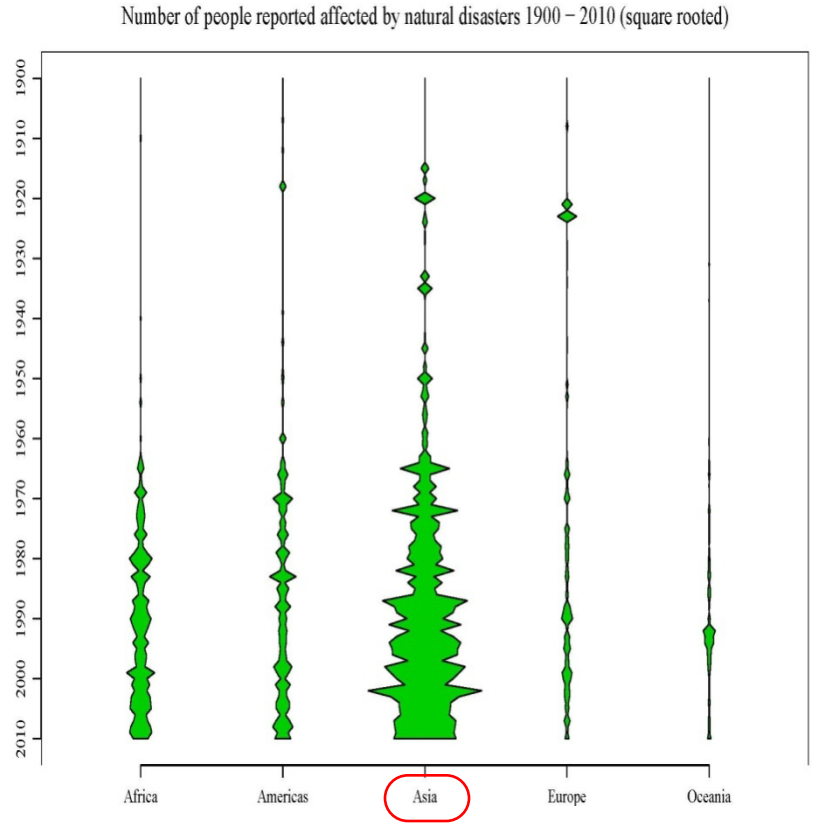
I. By Types

- **floods, droughts and storms are top three and growing rapidly since 1980‘s**

II. By Regions

- **Asia increases much more dramatically than others.**

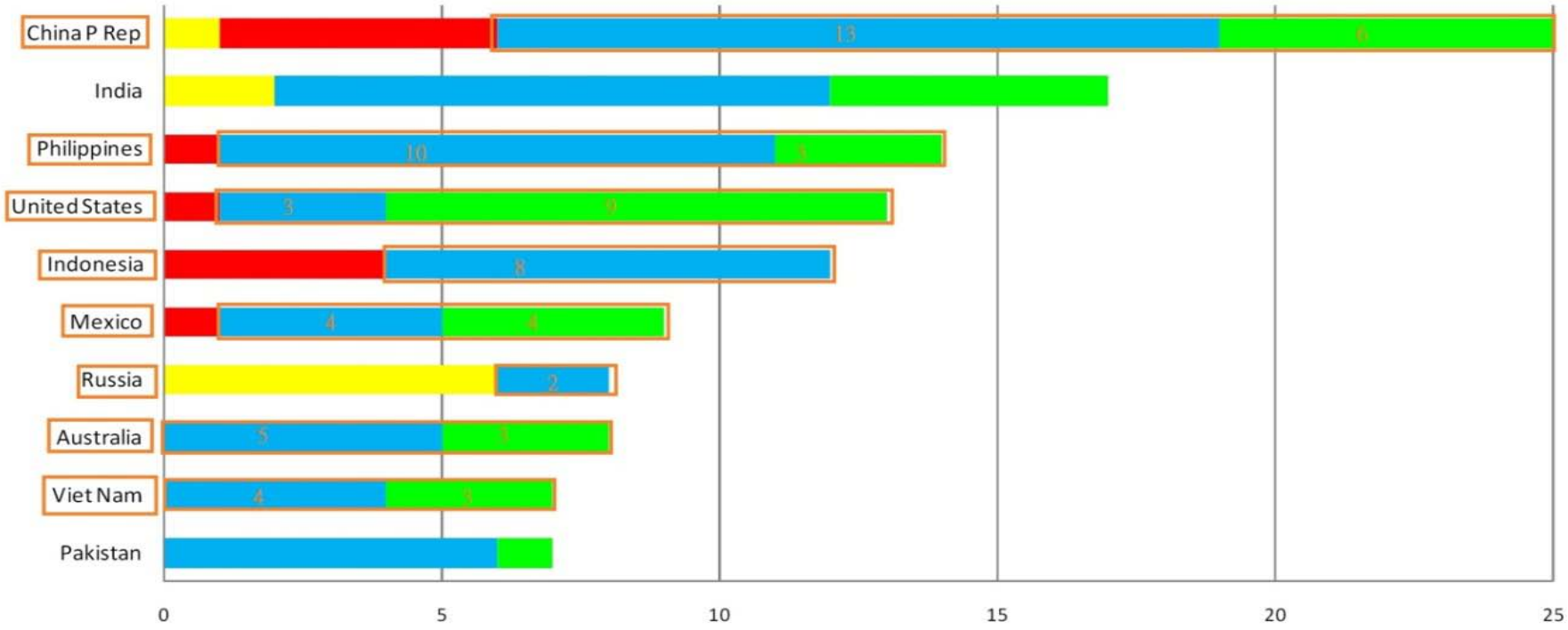




Source: EM-DAT: The OFDA/CRED International Disaster Database.

Top 10 by number of reported events , 2010

- APEC account for the majority attacked frequently
- Hydrological disaster was the most prominent type.

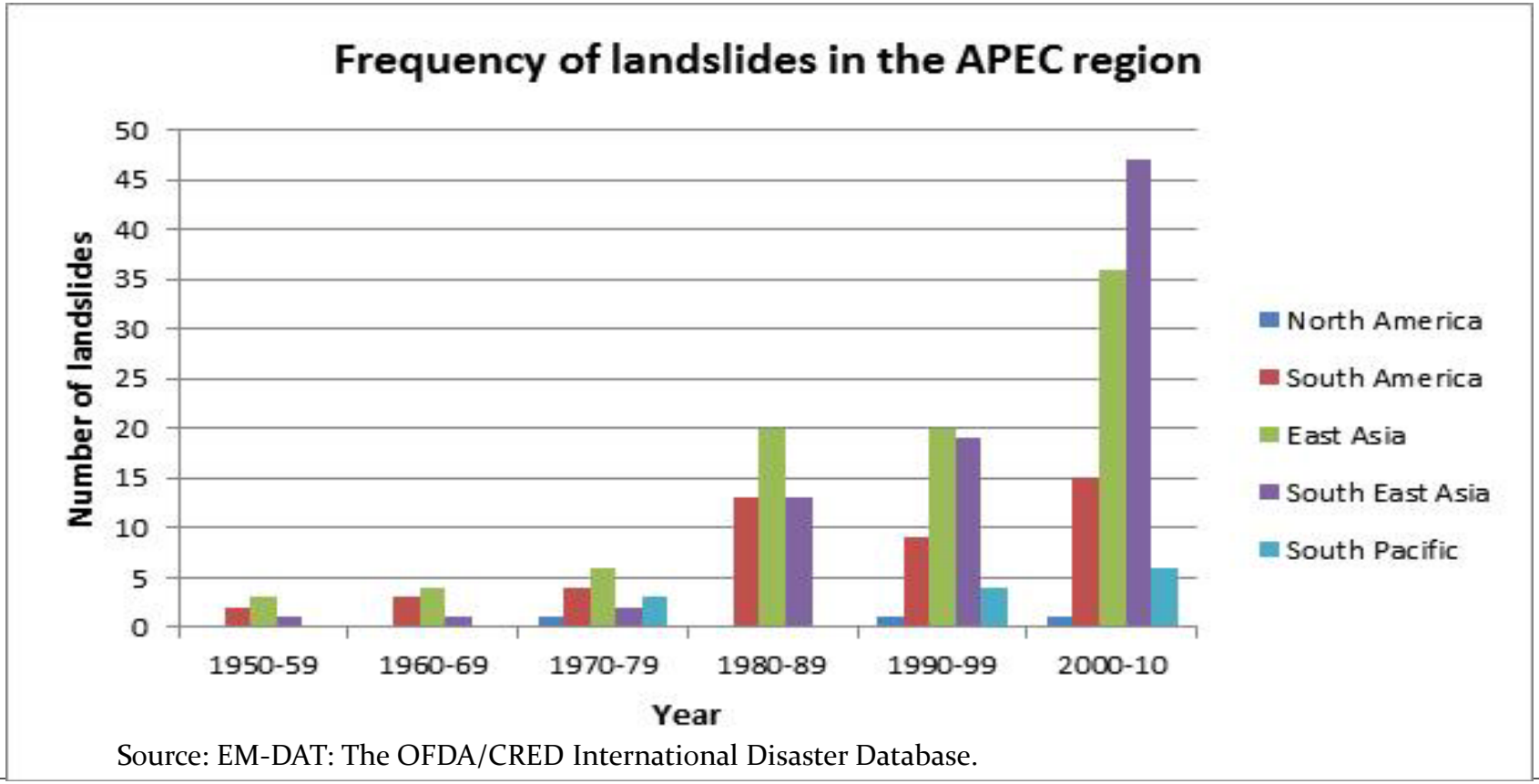


	China P Rep	India	Philippines	United States	Indonesia	Mexico	Australia	Russia	Pakistan	Viet Nam	Total
Climatological	1	2	0	0	0	0	0	6	0	0	9
Geophysical	5	0	1	1	4	1	0	0	0	0	12
Hydrological	13	10	10	3	8	4	5	2	6	4	65
Meteorological	6	5	3	9	0	4	3	0	1	3	34
Total	25	17	14	13	12	9	8	8	7	7	120

Source: Guha-Sapir D, Vos F, Below R, with Ponserre S. *Annual Disaster Statistical Review 2010: The Numbers and Trends*. Brussels: CRED; 2011.

Occurrence of landslide incidence in APEC region from 1950 to 2010

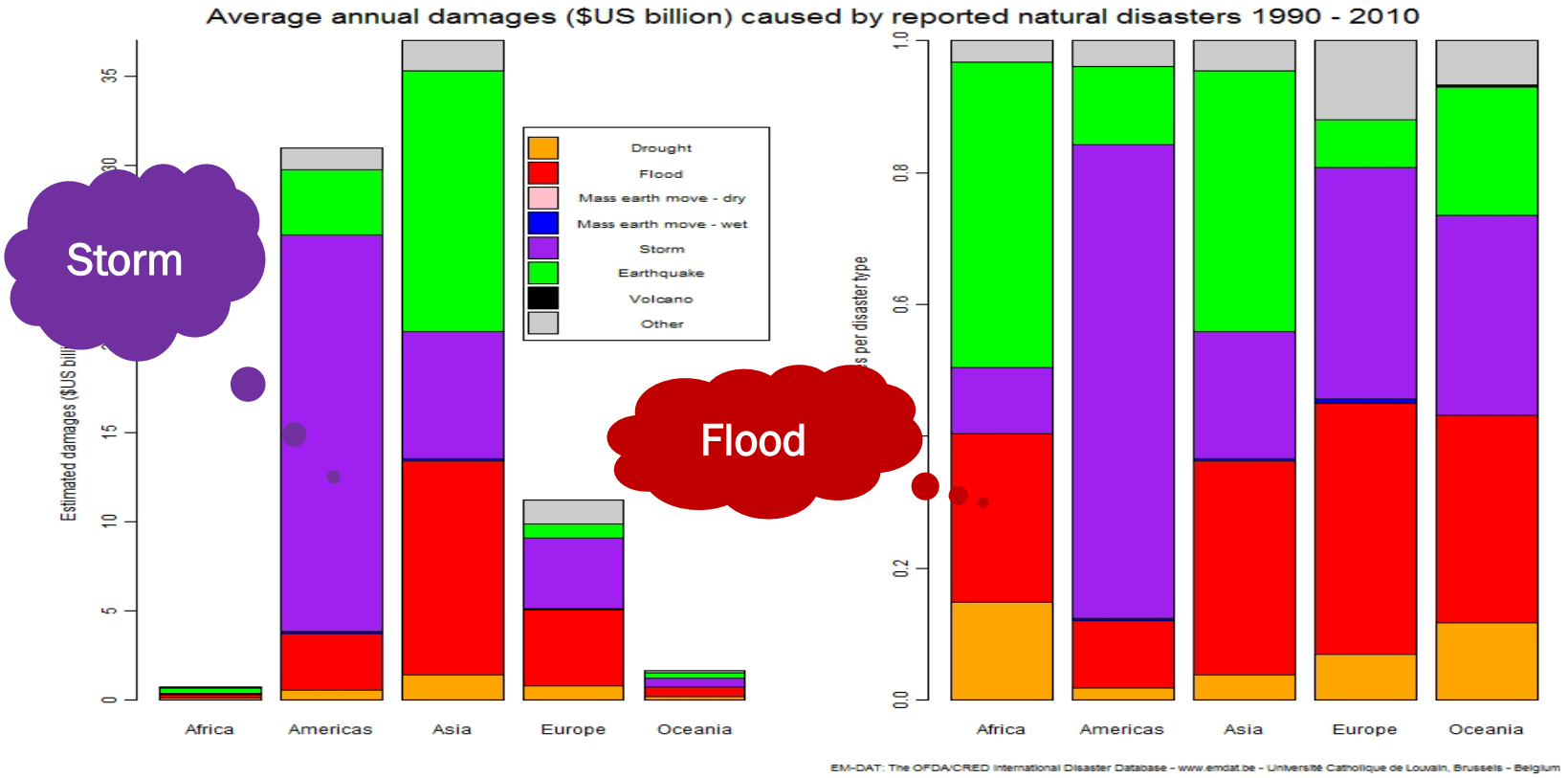
- Occurrence of wet landslides significantly out numbers dry ones
- Frequency of wet landslides appears to be increasing over time.



Source: EM-DAT: The OFDA/CRED International Disaster Database.

Economic Losses in 1990-2010

- Asia and the America suffered more losses
- Storms and floods
  - took a share of more than 50%
  - were responsible for the majority of damages in the Americas.



Source: EM-DAT: The OFDA/CRED International Disaster Database.

The Impacts of Monsoon

- The 2011 Thailand Flood

The 2011 Thailand Flood

A United States Navy helicopter surveys flooded areas in the outskirts of Bangkok.

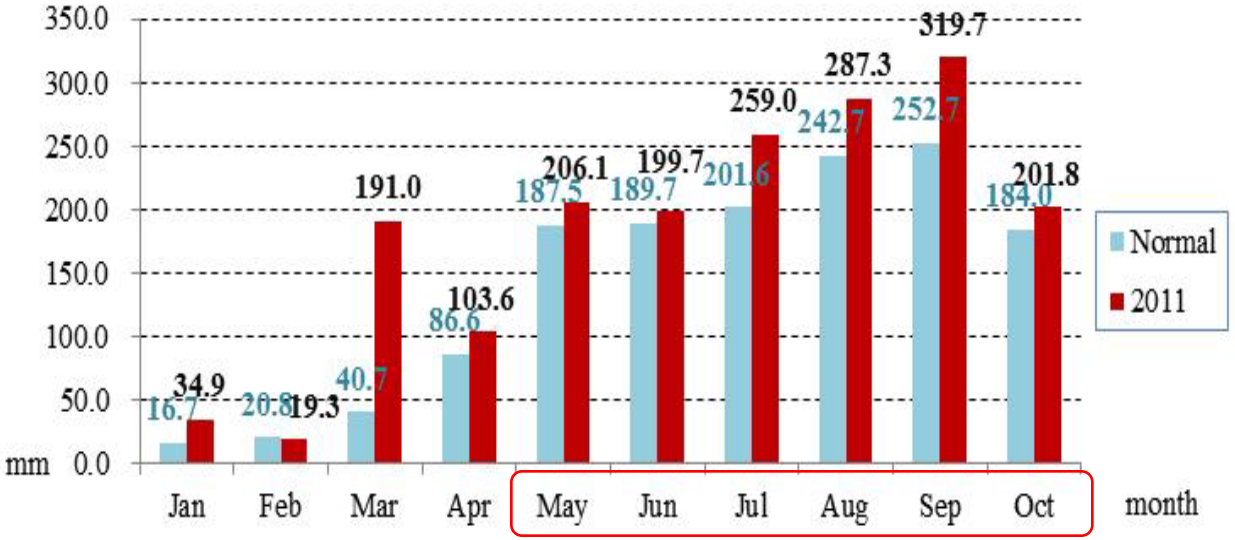
The 2-metre-high inundation has affected the Rangsit campus of Thammasat, north of Bangkok.

Photos Source: Wikipedia website, the free encyclopedia (http://en.wikipedia.org/wiki/File:2011-10-24_Thammasat_University_Inundation_(006).jpg and http://en.wikipedia.org/wiki/File:Helicopter_survey_of_flooding_in_suburban_Greater_Bangkok,_22_October_2011.jpg).

The 2011 Thailand Flood

Monthly rainfall amount over Thailand from Jan.-Oct. 2011

- 18-67 millimeters of rainfall amount above the normal amount from May to October.



Data Source: Thai Meteorological Department

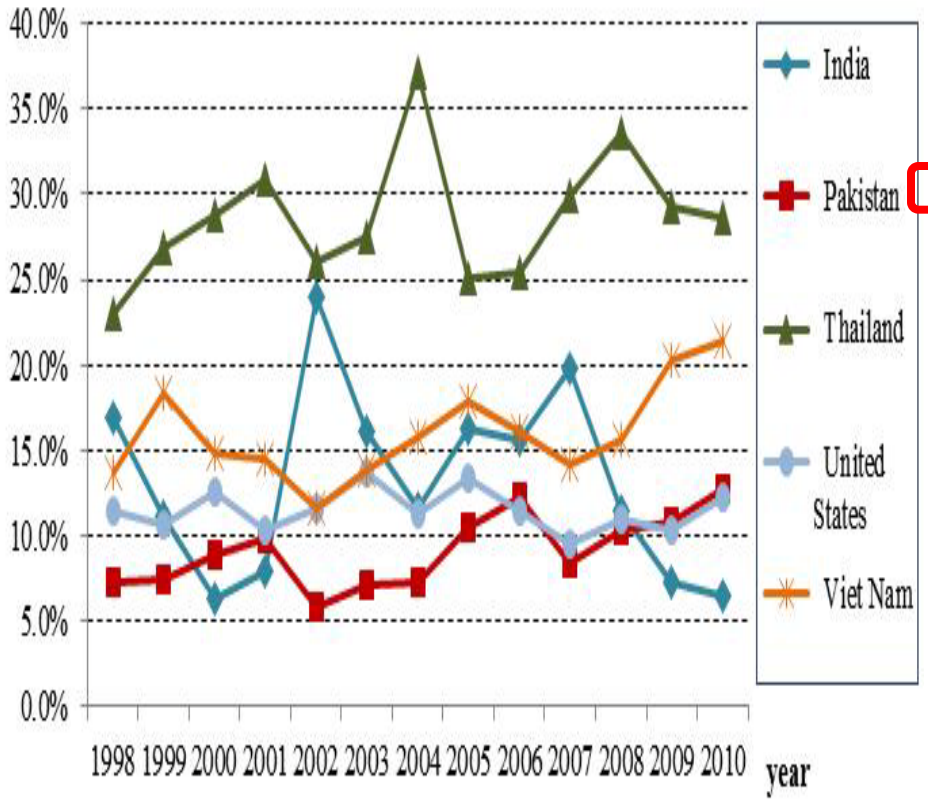
Observed flooding area in Thailand

- The flooding areas mostly occurred in northeastern and central province

Photo Source: Esri, http://www.esri.com/services/disaster-response/floods/index.html, Oct 2011.

World Rice Export Countries

Share of rice exported from major economies



Source: United States Department of Agriculture, Rice Yearbook 2011.

World top 10 milled rice exporters

- Thailand is the largest exporter of rice

2008			2009			2010		
Economy	Exports*	%**	Economy	Exports*	%**	Economy	Exports*	%**
Thailand	10,011	33.6	Thailand	8,570	29.2	Thailand	9,047	28.6
Vietnam	4,649	15.6	Vietnam	5,950	20.3	Vietnam	6,734	21.3
India	3,383	11.4	Pakistan	3,187	10.9	Pakistan	4,000	12.7
USA	3,267	11.0	US	3,017	10.3	USA	3,856	12.2
Pakistan	3,050	10.2	India	2,123	7.2	India	2,052	6.5
China	969	3.3	Burma	1,052	3.6	Cambodia	1,000	3.2
Egypt	750	2.5	Uruguay	926	3.2	Uruguay	808	2.6
Uruguay	742	2.5	Cambodia	800	2.7	China	619	2.0
Burma	541	1.8	China	783	2.7	Egypt	570	1.8
Brazil	511	1.7	Argentina	594	2.0	Argentina	468	1.5

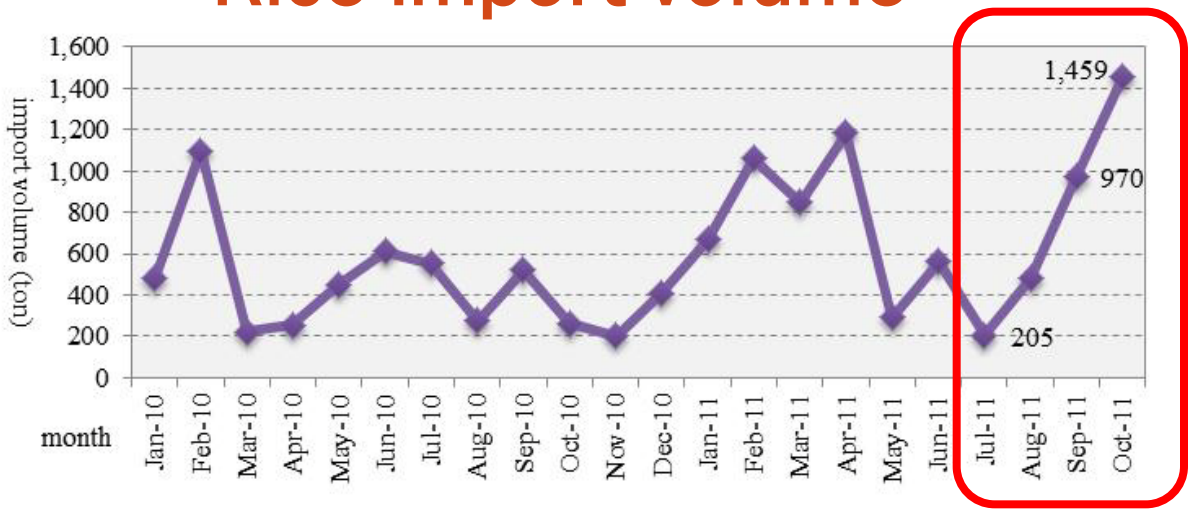
Source: USDA, Rice Yearbook 2011.

*1000 tons

**the percentage=the exports of each economy/the world total*100%

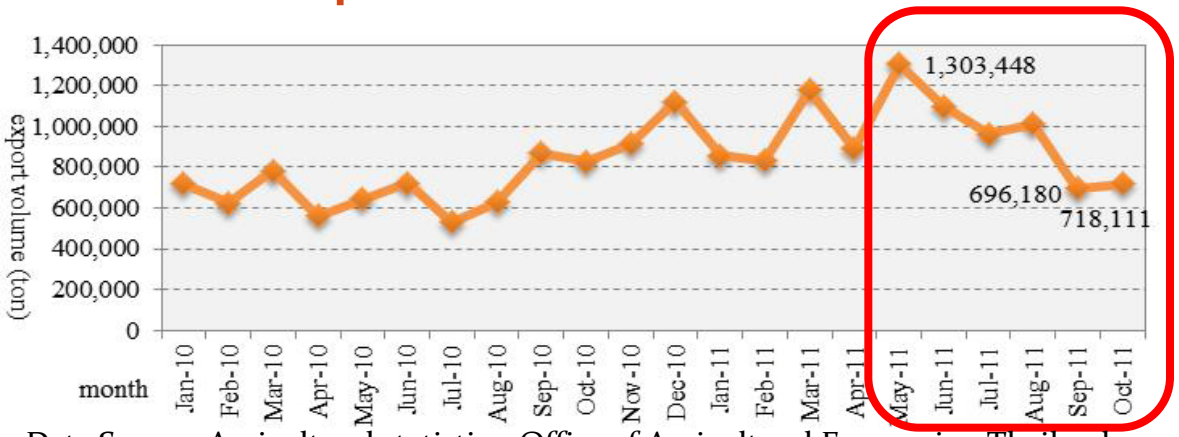
World Rice Trade from Jan. 2010- Oct. 2011

Rice import volume



- Import volume increase from 205 tons to 1,459 tons since July 2011

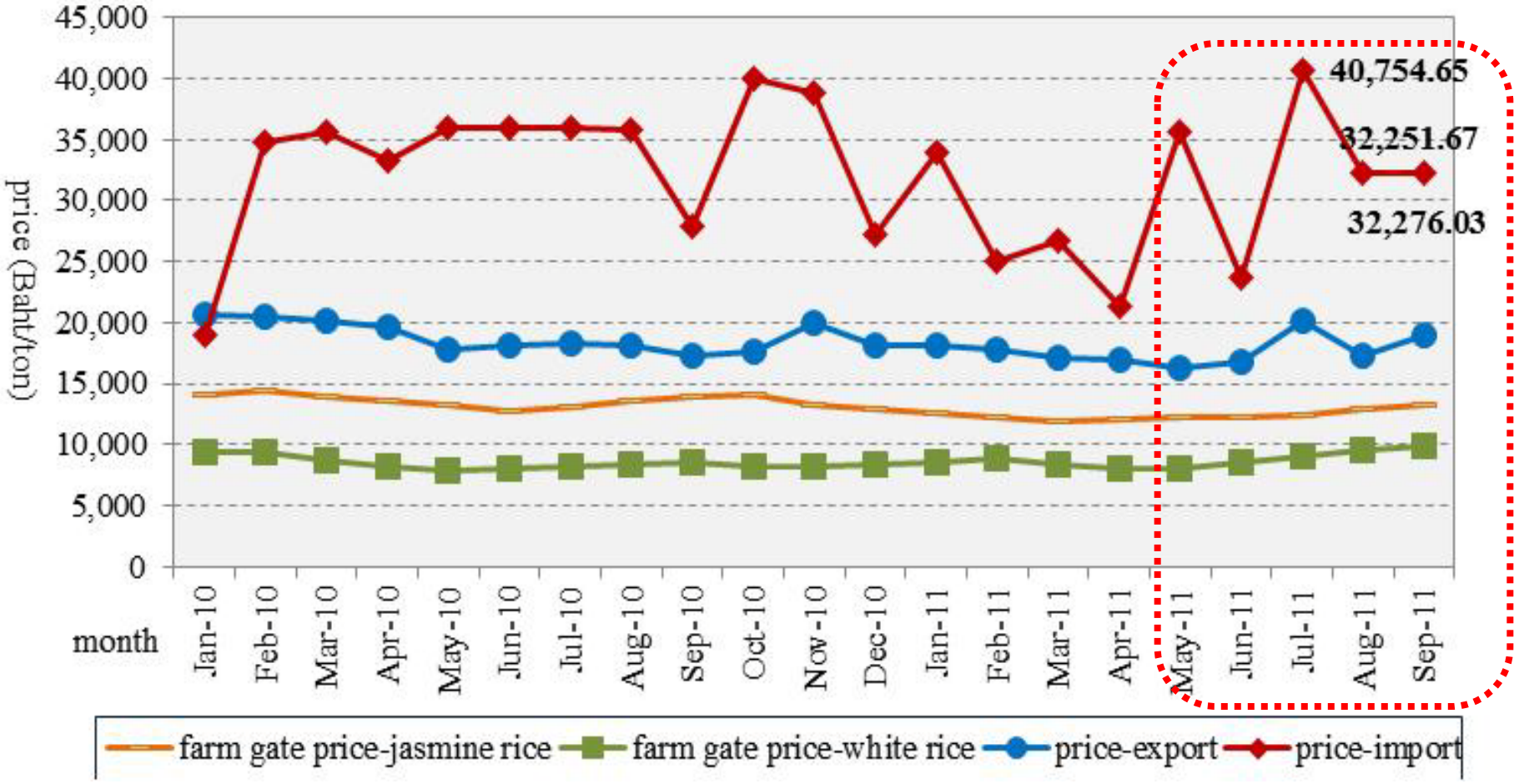
Rice export volume of Thailand



- Decline in Thailand rice export came in Aug. and Sep.

Data Source: Agricultural statistics, Office of Agricultural Economics, Thailand

Monthly farm gate, export, import price 2010-2011.



Source: Office of Agricultural Economics, Thailand. Agricultural statistics, http://www.oae.go.th/oae_report/export_import/import.php.

The Impact of ENSO on agriculture

- The El Niño Southern Oscillation (ENSO) is another pervasive climate phenomenon associated with regional variations in climate
- The Case of Rice

Increasing strength and frequency of ENSO

- Enhance the variability of precipitation and stream flow in many ENSO-affected areas
  - Leading to greater risk of droughts and floods
- Indonesia following the 1997-98 ENSO event caused substantial threat to rural livelihood and attracted global attention.

Impact of ENSO on Rice Market

- Chen et al. (2008)
- Extreme and more frequent ENSO on rice
  - Based on a stochastic spatial equilibrium model
  - Negative impacts in the cold phases are more severe than they are in the warm event.
  - El Nino
    - Trade increase 32 million ton
    - Annual welfare loss USD 741 million
  - La Nina
    - Production decrease but no sig. effect on trade
    - Annual welfare loss USD 2,058 million

Warming Climate and Fishery Sector

Fishery Contribution to Food Security

- **Consumption:**
  - 20% of the world's population derives one-fifth of its animal protein intake from fish.
- **Employment:**
  - 2008 FAO estimated 43.5 million people are directly involved in fisheries and aquaculture
  - 86% of which living in Asia.
- **Trade:**
  - In low-income food-deficit countries (LIFDCs), fish is an important means of earning foreign exchange.

Regional production

		2006		2007		2008	
		tons	%	tons	%	tons	%
Africa	Aquaculture	570,217	1.2	833,145	1.3	955,237	1.4
	Inland	2,344,016	24.2	2,467,198	24.7	2,502,570	24.5
	Marine	5,212,122	5.8	4,716,338	5.8	4,765,603	5.9
Americas	Aquaculture	2,161,859	3.9	2,371,818	3.7	2,432,870	3.6
	Inland	608,599	6.1	579,037	5.8	556,552	5.4
	Marine	25,518,044	27.3	21,608,581	26.7	21,335,798	26.5
Asia	Aquaculture	49,463,979	91.0	59,099,348	91.2	62,442,864	91.4
	Inland	5,317,494	65.9	6,532,287	65.5	6,786,664	66.4
	Marine	38,903,974	48.9	40,259,783	49.7	40,604,351	50.4
Europe	Aquaculture	2,171,564	3.6	2,351,199	3.6	2,341,646	3.4
	Inland	318,098	3.6	376,609	3.8	357,057	3.5
	Marine	13,860,676	16.4	13,108,408	16.2	12,713,823	15.8
Oceania	Aquaculture	144,928	0.3	172,529	0.3	176,325	0.3
	Inland	17,668	0.2	17,802	0.2	17,786	0.2
	Marine	1,392,063	1.6	1,259,521	1.6	1,100,547	1.4
World Total	Aquaculture	41,672,529	100.0	44,249,732	100.0	47,276,122	100.0
	Inland	8,577,990	100.0	8,534,699	100.0	8,412,160	100.0
	Marine	85,914,870	100.0	83,150,900	100.0	83,468,946	100.0

Source: Fisheries and Aquaculture Department, http://www.fao.org/fishery/en.

Exports, Consumption, Governance

Continent level of undernourishment	Percent of world population	fishery products net exports (metric tons/year)	fishery products consumption (kg/person per year)	Pop. weighted avg. governance
World				
Low	29.3	–7,838,123	21.72	0.63
Moderate	31.1	3,387,403	20.05	–0.40
High	37.9	3,182,602	9.03	–0.51
Africa				
Low	3.1	73,540	11.09	–0.13
Moderate	3.7	–935,520	10.71	–0.87
High	7.1	289,134	5.57	–0.93
Asia				
Low	**6.6**	**–5,462,261**	**31.89**	**0.32**
Moderate	**22.4**	**3,858,470**	**24.21**	**–0.36**
High	**30.0**	**2,912,576**	**9.95**	**–0.41**
Europe				
Low	11.3	–2,376,047	20.09	0.68
Moderate	0.0	0		
High	0.0	0		
North America				
Low	7.0	–2,190,357	20.54	1.17
Moderate	0.3	–51,508	9.48	–0.28
High	0.6	–11,711	5.22	–0.73
Oceania				
Low	0.4	90,891	25.69	1.79
Moderate	0.0	91,751	34.14	–0.77
High	0.0	0		
South America				
Low	0.9	2,026,111	11.07	0.07
Moderate	4.7	424,210	8.16	–0.19
High	0.1	–7,397	1.61	–0.58
South America				
Low	0.9	2,026,111	11.07	0.07
Moderate	4.7	424,210	8.16	–0.19
High	0.1	–7,397	1.61	–0.58

Source: Smith et al. (2010).

Sea Level Rise (SLR) and Rice Production

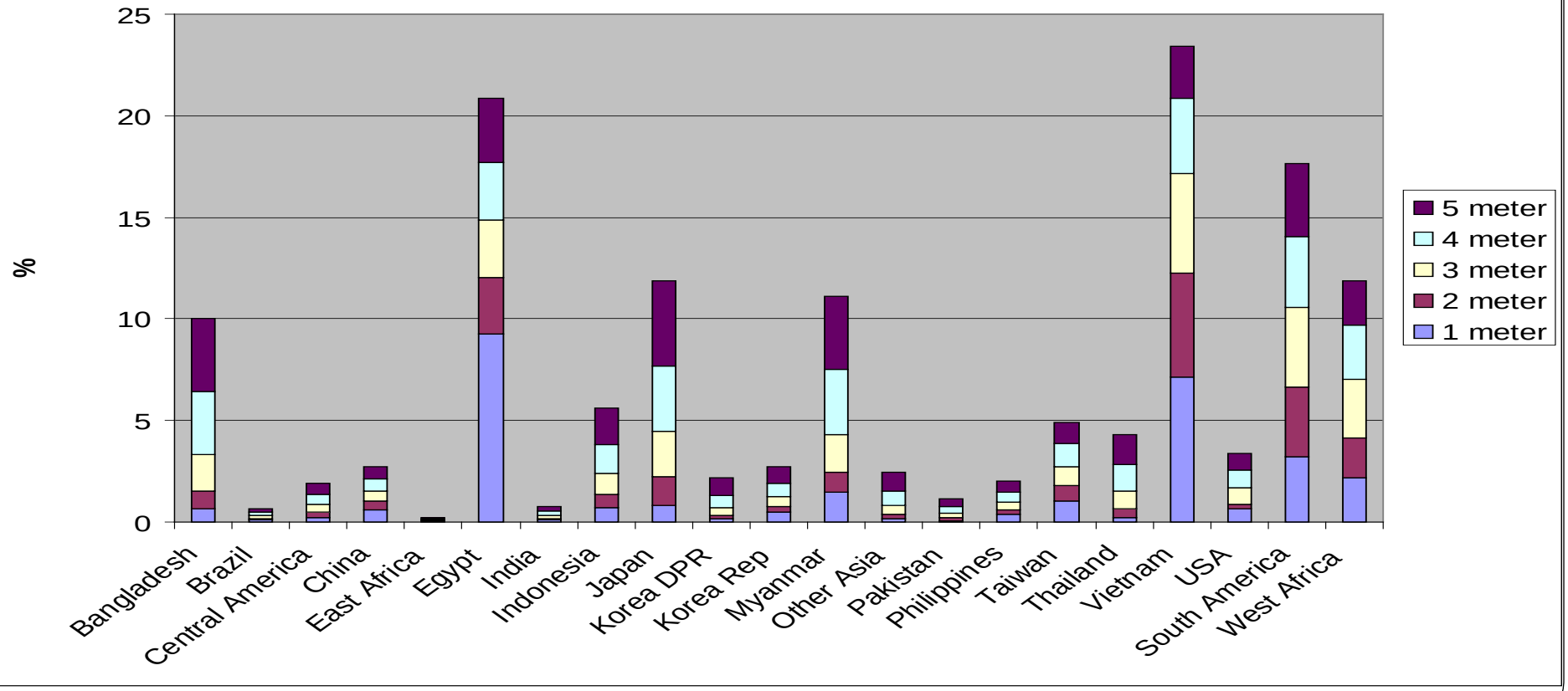
SLR due to climate change is a long-term threat to portions of society including agriculture

Some predict larger rates for the future

- Raper and Braithwaite (2006) project annual sea level rise caused by melting mountain glaciers and icecaps will fall between 0.046 and 0.051 meters by 2100
- Meier et al. (2007) estimate an additional 0.1 to 0.25 meters of sea level rise by 2100 due to glacier and ice cap melting.
- The Intergovernmental Panel of Climate Change (IPCC) fourth assessment report projects 0.18 to 0.59 meters sea level rise without consideration of ice melting by 2100.
- Rahmstorf (2007) projects a cumulative sea-level rise of 0.5 to 1.4 meters by 2100.
- Dasgupta et al. (2009) projects 1 to 3 meters of rise but indicates as much as 5 meters is possible if the unexpected rapid breakup of Greenland ice cover and West Antarctic ice sheet occurs.

Impacts on Agricultural Land

- Inundate 0.39% to 2.10% of global cropland
- Occurs in ag land in SE Asia, E Asia, S Asia, SE US
- Constitutes a threat to rice



Source: Dasgupta et al. (2009).

Space Information Technology Development

Remote Sensing Technology

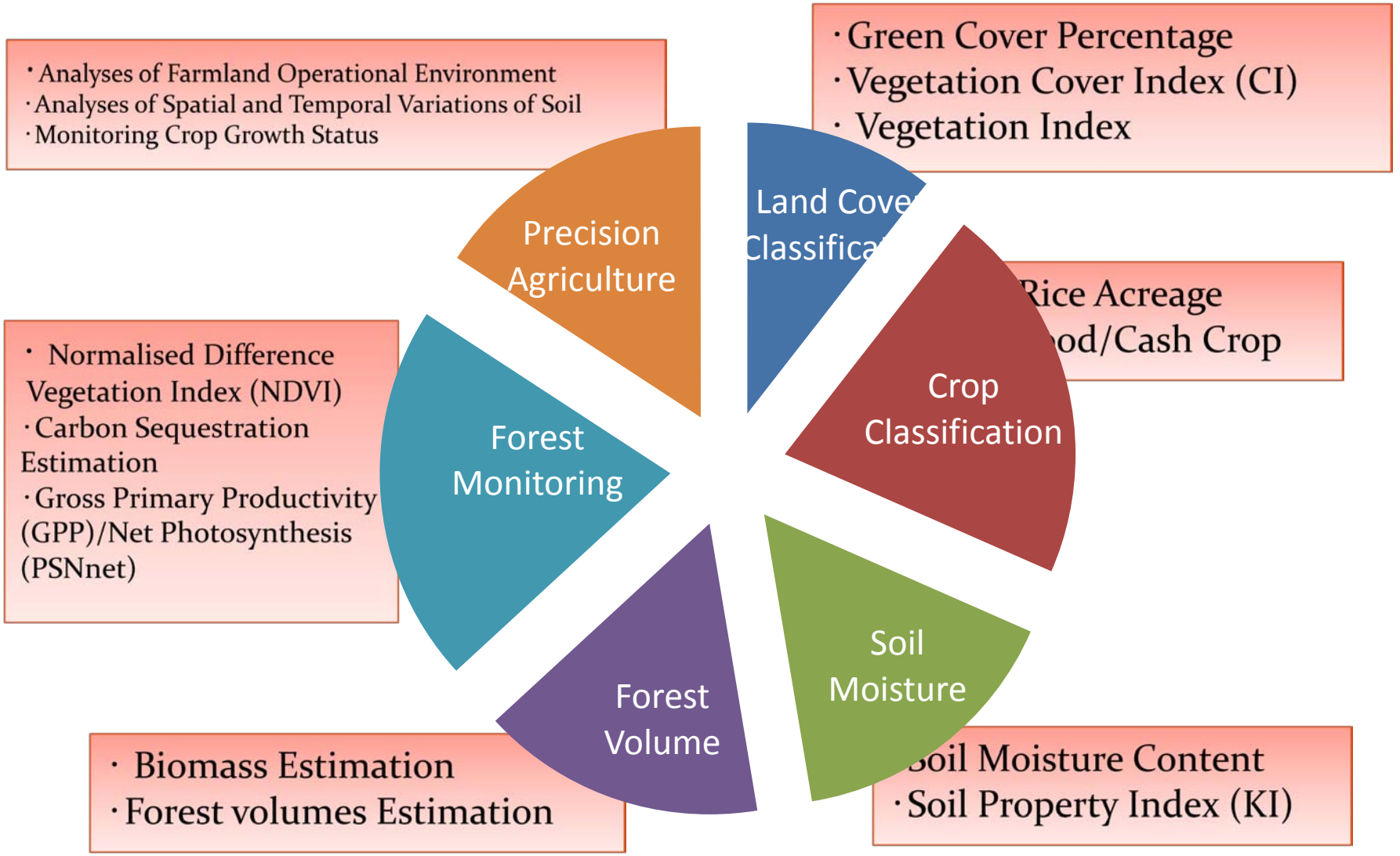
Name		Application	Indicator
Doppler Radar	3D	meteorology	Rainfall
Synthetic aperture radar (SAR)	3D	environment/ geology/ landcover landuse/ forest /veg. type	Deformation, soil moisture content
Earth observation Satellite	2D	environment/ meteorology	
Weather satellite	2D	weather/climate	
Air photo	2D	environment	
MODIS-Moderate Resolution Imaging Spectro-radiometer	2D	Atmosphere, Land, and Ocean	Potential evapo-transpiration

Application of Remote Sensing

- Satellite photographs showing flooding in Ayutthaya and Pathum Thani Provinces in October (right), compared to before the flooding in July (left)

Source: Wikipedia website, the free encyclopedia (http://en.wikipedia.org/wiki/File:2011_flooding_in_Ayutthaya_Province-EO-1_merged.jpg

Remote Sensing Application



Soruce: Shoei-Jui WU, Communication Research Center, NCU.

Regional Early Warning Systems

- By integrating the constellation of multi-SAR systems, frequent observations is highly feasible and provide update information about the structure
- Gives all countries access to similar timely and accurate early warning products at the scale of the region would provide a good tool for decision-making
- Benefit from the fast developing information technologies in establishing satellite-linked networking for faster communication and linkages

Conclusion

- The rising consumption of food by many Asian countries may underscore the vital contribution of agriculture to the food security in this region.
- Responsibility of decision makers is to find practical solutions to ensure a sustainable agricultural transformation.
- Through support from public and private sector commitments on basic research and innovation-driven solutions for
  - Better understanding of the complex interrelationships between social, economic, biophysical, geochemical and climate systems;
  - Effective cooperation among key stakeholders, facilitated by better-designed institutions and governance arrangements.

THANK YOU &
COMMENT WELCOME