UNDERSTANDING RISK

Innovation in Disaster Risk Assessment

Flood Modelling for Agricultural Risk Management and Insurance

Alexander Lotsch, William Dick, Ornsaran Manuamorn

GEM GLOBAL EARTHQUAKE MODEL

GFDRR GLOBAL FACILITY FOR DISASTER REDUCTION AND RECOVERY

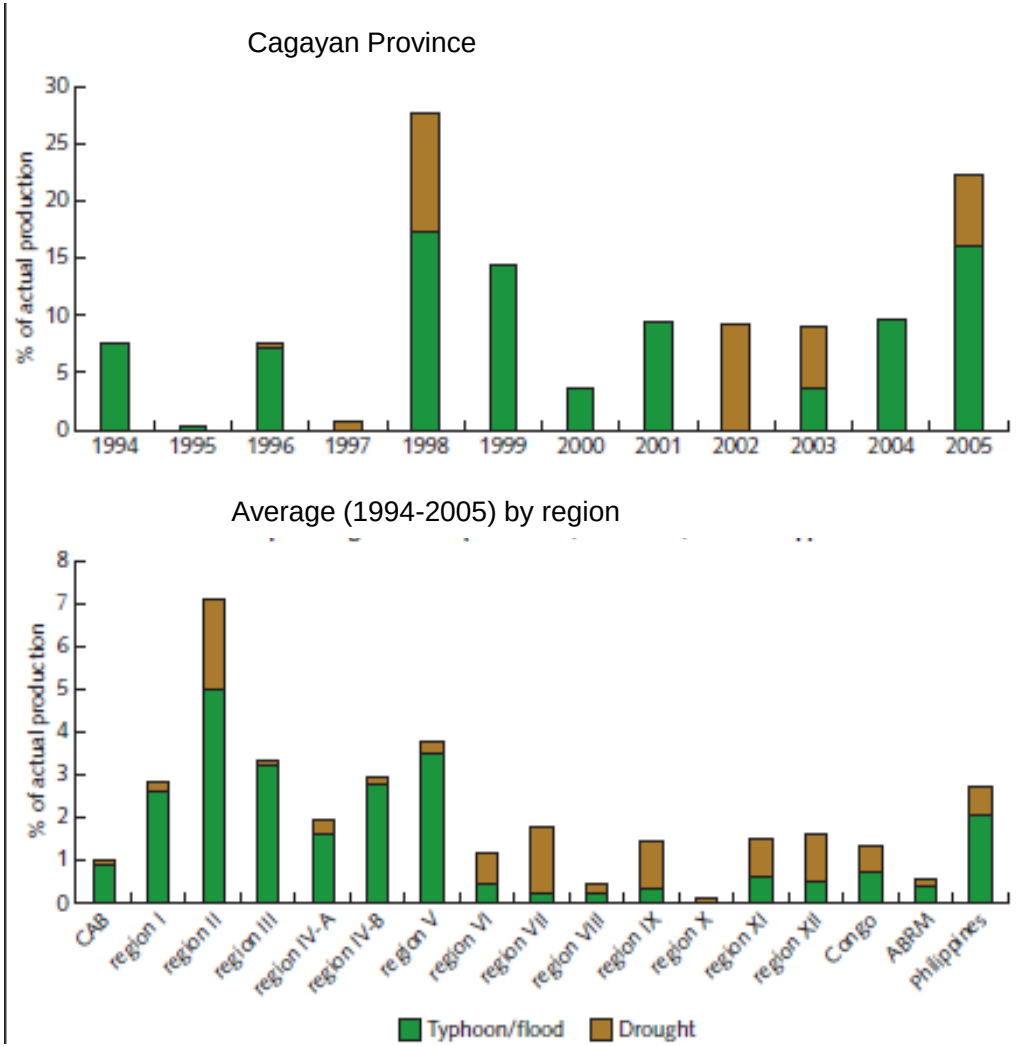
ISDR

connecting knowledge FOR GLOBAL EXCELLENCE

Agricultural Flood Losses

- High at local level
- Difficult to estimate globally

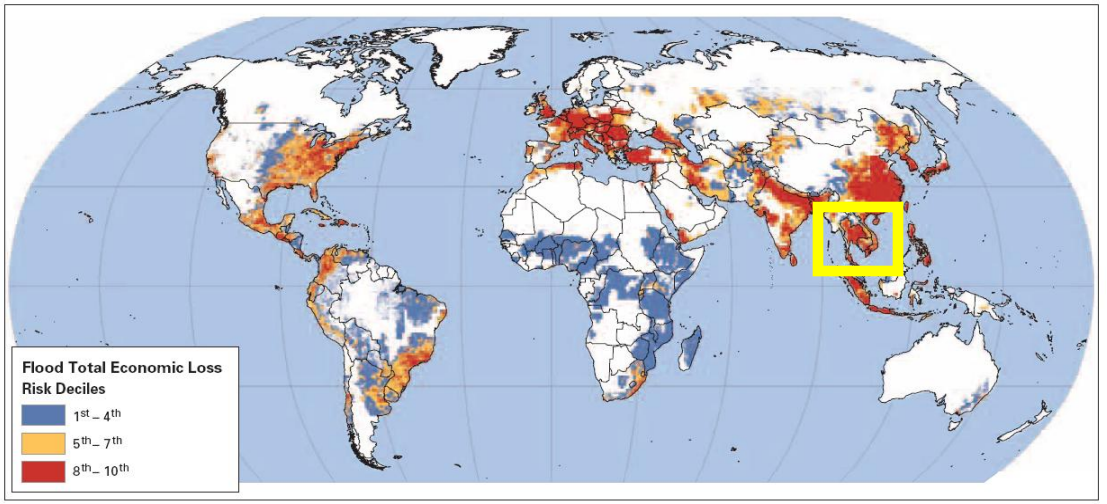
Philippines: Palay losses (% of actual production)



Experience: Floods in SE Asia

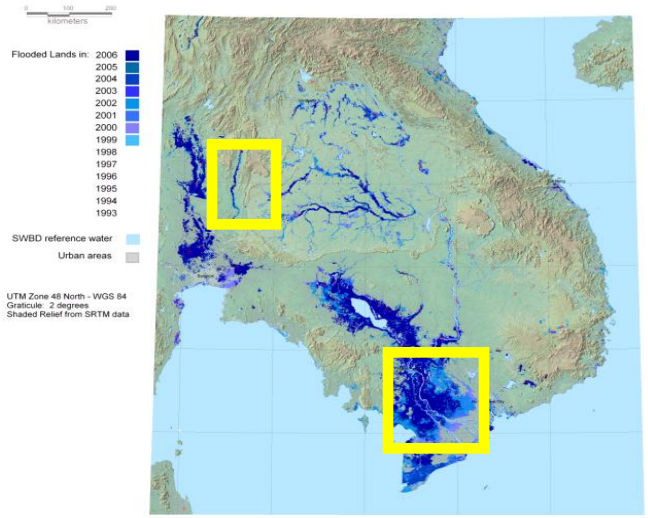
- Demand for insurance solutions for agricultural floods risk
- Assess feasibility of flood index insurance

Relative economic losses due to flood

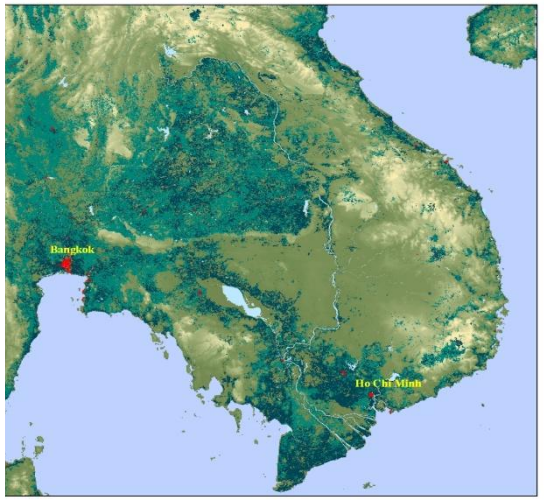


Source: WB 2006, Disaster Hotspots

Recent floods

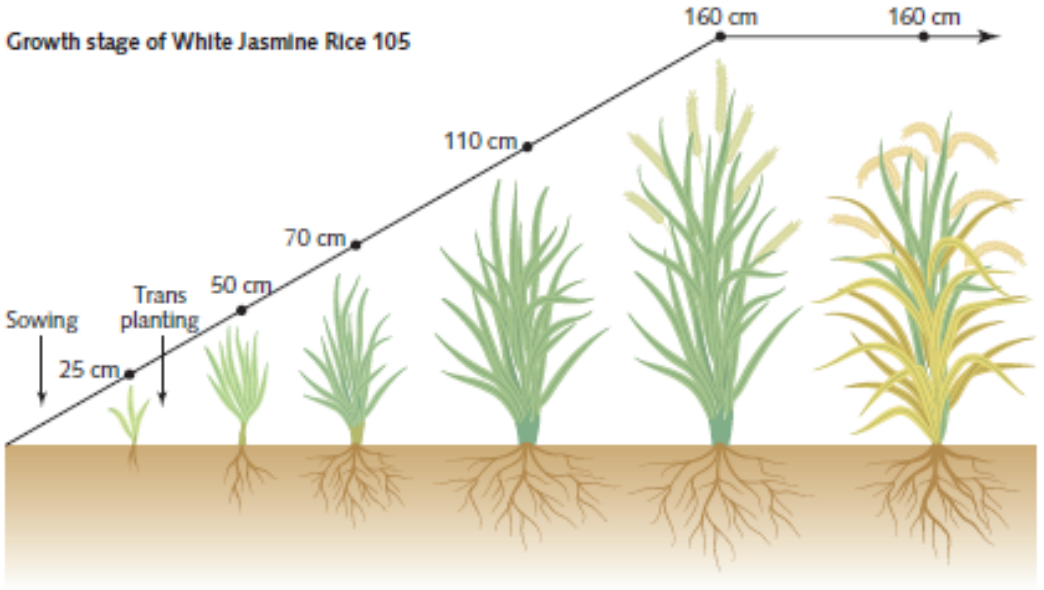


Agricultural extent



Modeling floods

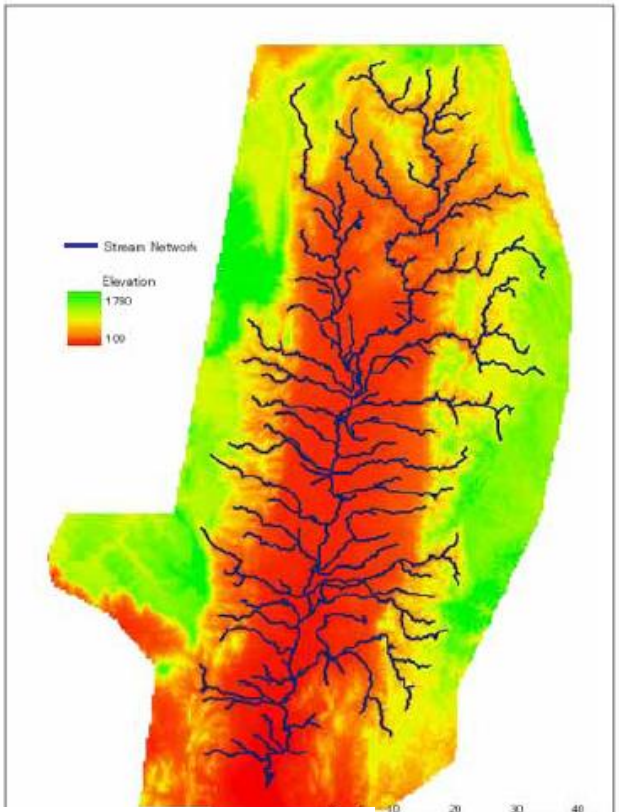
Too much water… where and when …?

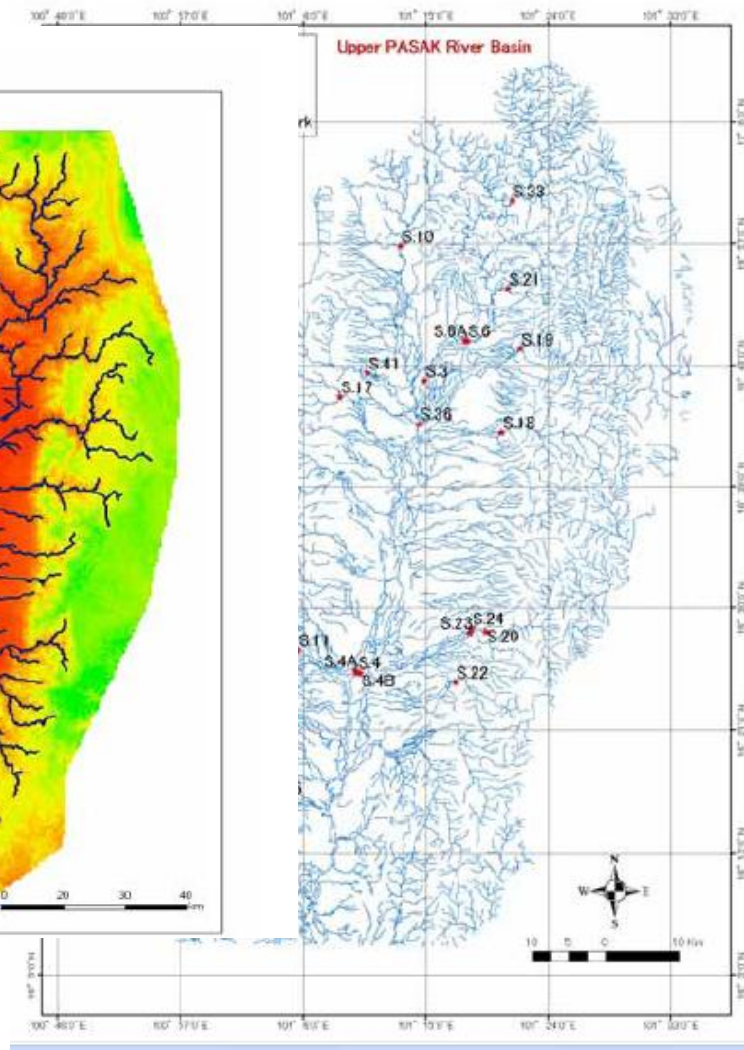


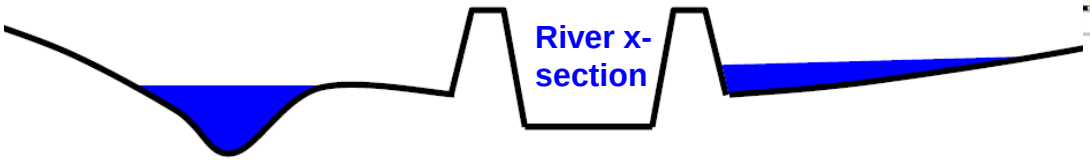
Growth Stage	June	July	Aug	Sep	Oct	Nov	Dec
	Seeding	Transplant	Tillering	Booting	Flowering	Reproductive (Grain Filling)	Harvesting day
Rice height (cm)	0–25	25–50	50–70	70–110	110–160	160	160
Critical water depth (cm)	25	25	40	70/20*	160	160	160
Critical flooding duration (days)	>3	>3	>4	>4	>4	>4	>4

Modeling Flood Risk

- A lot more technical work and data is required to model flood risk (compared to drought risk)
  - Topography
  - Hydrology
  - Land use
  - Infrastructure
  - Satellite data
  - Location of farmers
  - … and more …



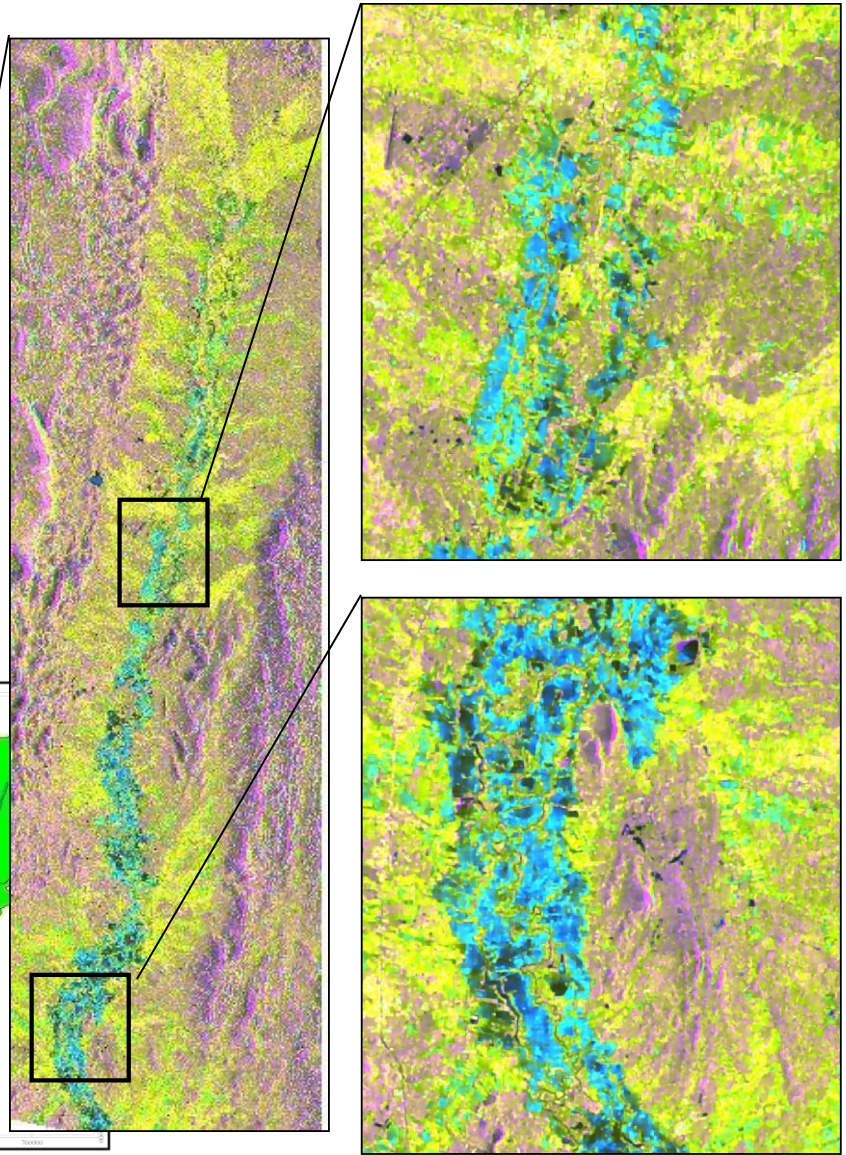




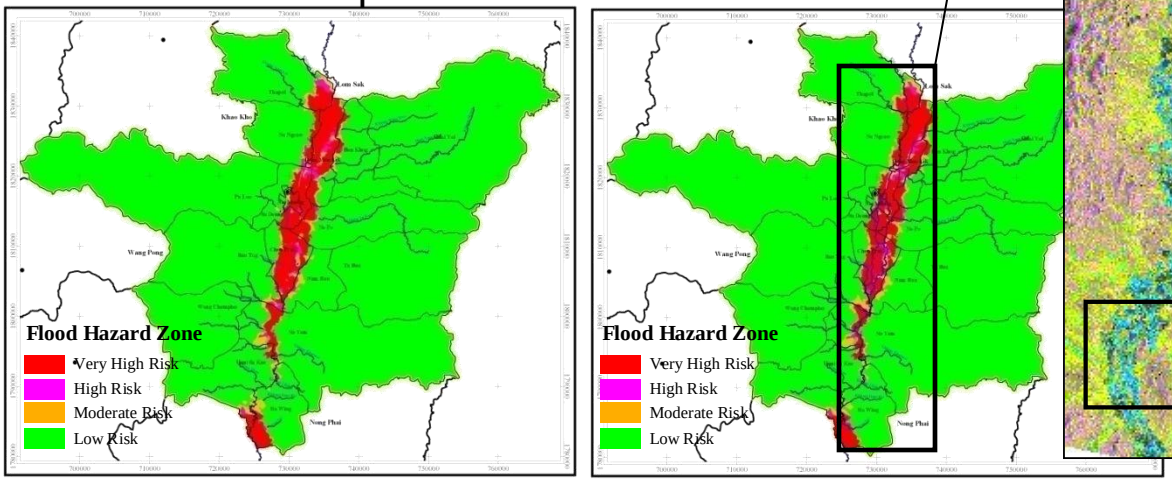
Use Satellite Remote Sensing

- To validate flood model output, monitor floods
- As basis for targeted compensation
- Readily available, cheap, in-country capacity

'Observed' Flood Depth and Extent

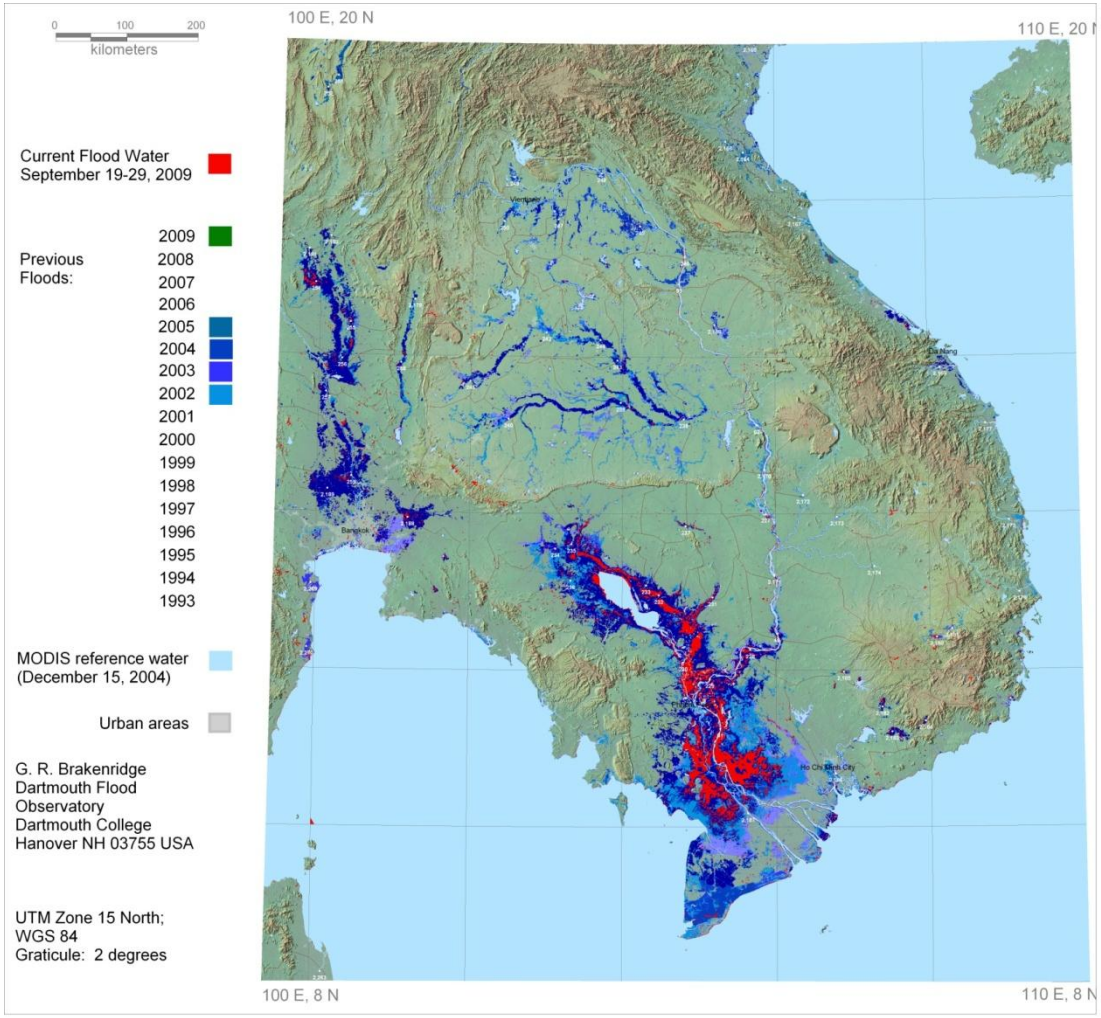


Modeled Flood Depth and Extent



… or estimate flood extent (return periods) directly from satellite

- Alternative to uncertain and complex modeling
- Derived from coarser (more frequent) satellite images
- ~ 10 year archive of direct flood observation
- Allows estimation of flood extent with higher return periods (i.e. limited use for insurance)



Flood Risk Management

Crop and livestock flood insurance :

- Not widely available internationally except some high income countries with Multiple Peril Crop Insurance
- Difficulties
  - Localised risks
  - Flash flood, riverine flood, typhoon/coastal flood
  - Pricing, zoning, anti-selection
  - Field loss assessment for small farms
  - Catastrophe exposures

Motivation to research feasibility: could index principles used in index insurance be applied to flood risk?

Flood insurance or flood compensation ?

	Flood Insurance	**Flood Compensation**
Legal basis	Contractual, in advance	Non-contractual, ad hoc
Enrollment of farmers	Enrolled in advance	Not normally registered ex ante
Compensation	Methodology and valiues agreed in policy	Rarely formalised ex ante
Implementing agency	Insurance company	Government agency
Funding	Premiums (+? subsidies)	National budgets; donors
Managing cat risks	Reinsurance	Cat fund, budget reallocation… Often not formalised ex ante
Objectives	Meet asset losses and/or recovery costs	Humanitarian relief; replanting materials; cash for work etc

- Flood Insurance has advantages as part of wider flood DRR, if it is feasible
- Can some principles of index insurance be applied to agri flood insurance ?

Steps in flood index insurance product design

- **Defining the Hazard**
  - Flood modelling: define the flood risk zones; types of flood risk
  - Remote sensing: validate FM output with archive imagery
- **Defining the Vulnerability**
  - Extent of yield loss according duration, depth, crop growth phase and planting dates
- **Defining the exposure**
  - GIS: mapping of farm locations
- **Design options for index phases and payouts measurement**
  - Design index thresholds, incremental payouts, limits, insured values, windows
  - Determine how to measure flood (spatial extent, location) objectively
- **Pricing the index**
  - Flood modelling: time series of flood extent and duration for each zone
- **Validating the index**
  - Correlate against other known damage or yield data

A prototype micro level flood index

Claim Eligibility Trigger

One time excess of "Bench Mark Level" at **115.89** cm. at the Pasak River Water Gauge station (ID: S4:B)

OR

177 mm. from average 4 day rainfall at 3 stations (Upper: 379002; Middle: 379401; Lower: 379201)

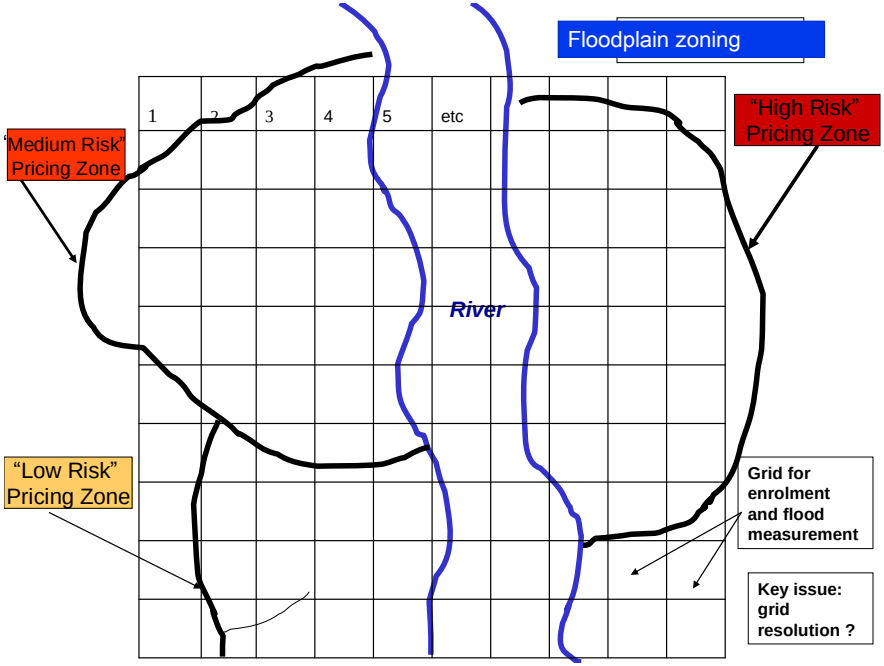
Payout Index

Days of inundation of 60 cm. flood	**Yield Damage**
3 days	No damage
4 days	20% loss
5 days	60% loss
6 days	80% loss
7 days	100 % loss

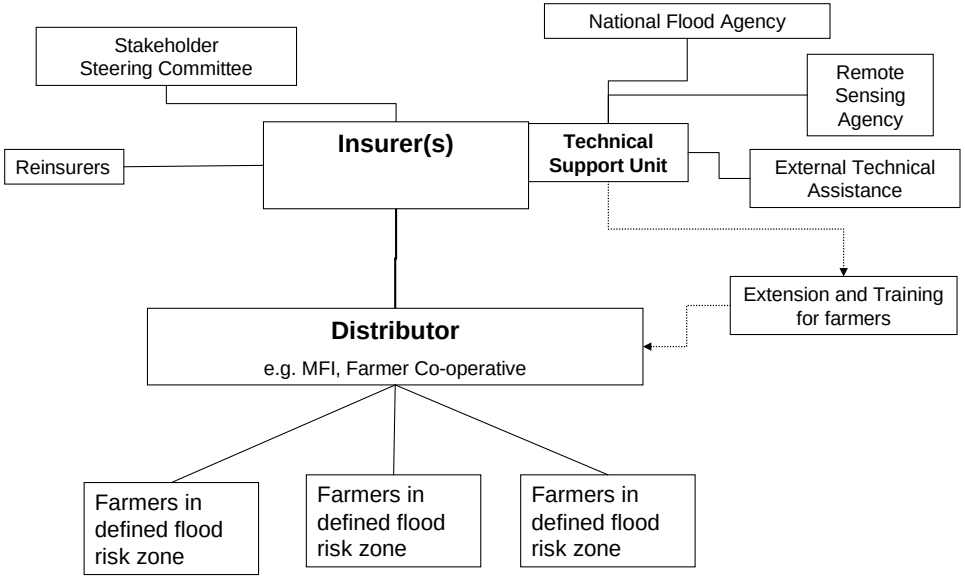
Event triggered by rainfall or river gauge; payout scale based on remote sensing
BUT – very difficult to design product at this level of detail

Organizing Flood Insurance

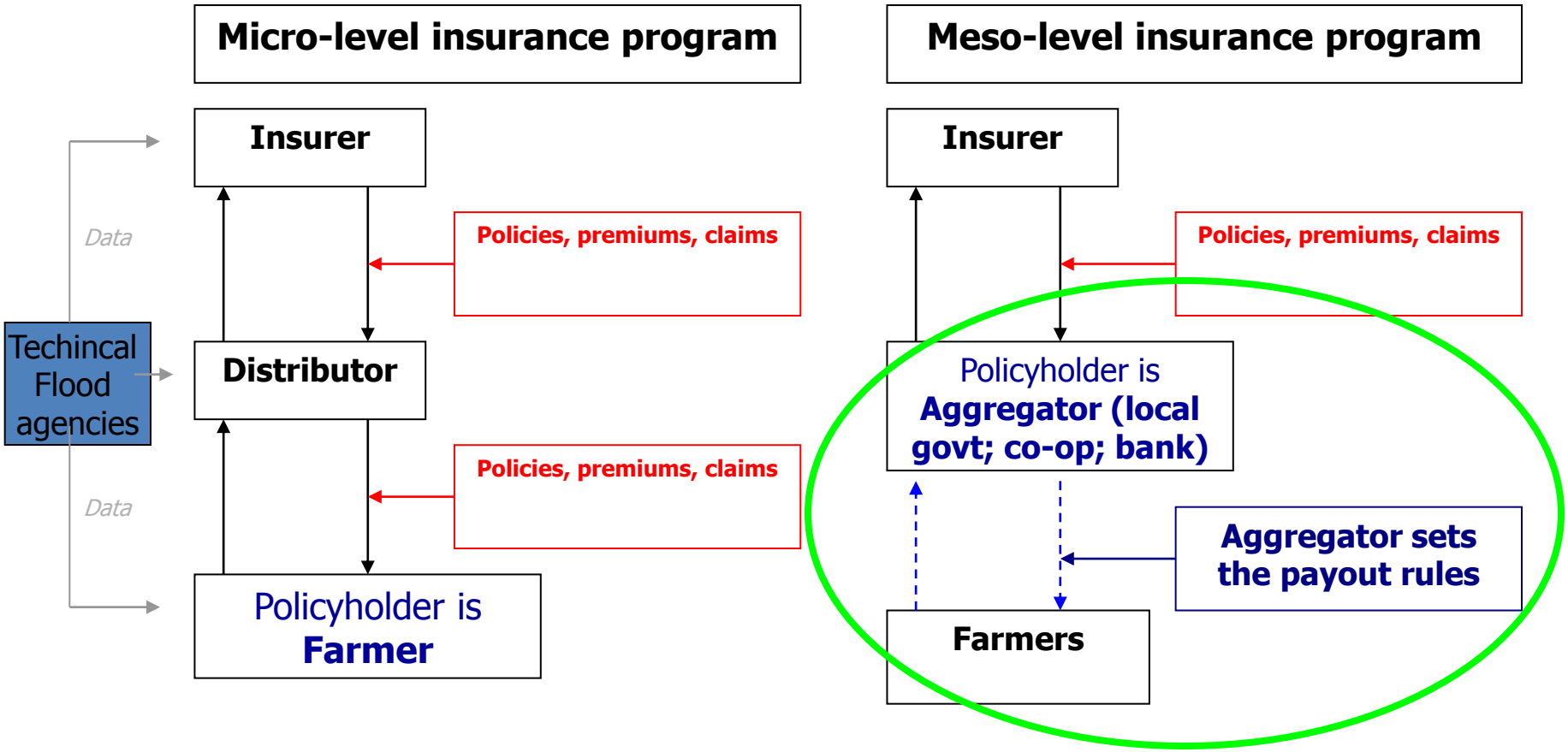
- Group farmers based on homogenous flood risk (based on modeling)
- Loss assessment supported by remote sensing
- **Resolution** is key issue



Organisational Structure for Micro level Flood Insurance



Structuring micro and meso level flood index insurance



- **A meso scheme requires an effective and trustworthy manager and setting of objective payout rules – at a farmer group, district, regional or catchment level**
- **At a macro level a government may be able to transfer the catastrophe flood risk, and use remote sensing to support an objective flood compensation system**

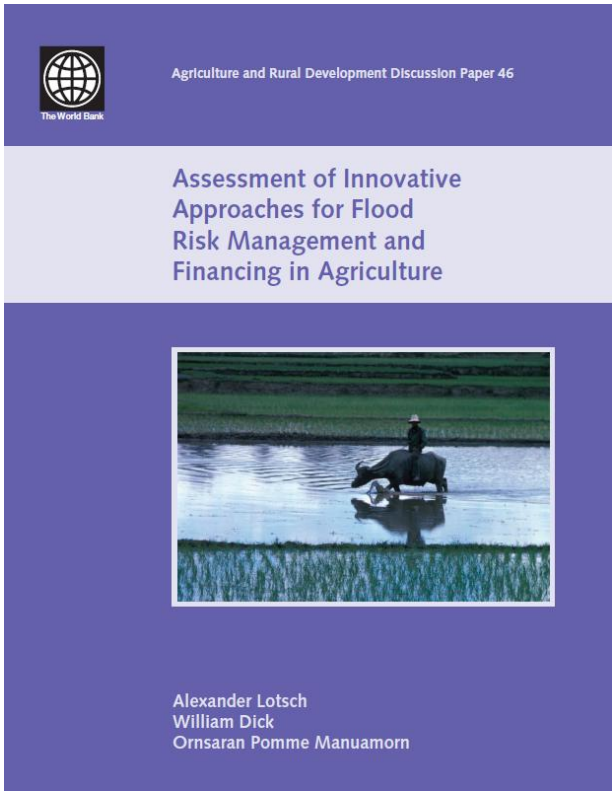
Some findings on feasibility of flood index insurance (1)

- **Delineating flood risk is challenging**
  - Direct and indirect damage
  - Different types of flood risk, not all can be modeled
  - Agricultural assets (crops) change over time (season)
- **Comprehensive/complex modeling needed**
  - Flood models (even simple models are relatively complex)
  - Different, heterogenous data sources (not just rainfall …)
- **Remote sensing** helps 'calibrate' flood models and assess flood impact, but requires technical capacity
- **Voluntary** insurance schemes are unlikely to be effective, due to adverse selection by higher risk farmers
- **Riverine** flood – often "high risk" or "no risk" – more uniformly and infrequently inundated areas are most suitable

Some findings on feasibility of flood index insurance (2)

- **Flood insurance is difficult to operate**
  - Floods are localized, can be mitigated, farmers know risk factors
  - May require mandatory enrolment, voluntary schemes problematic
  - Zoning necessary
  - Financial management difficult: valuation of damages is time-sensitive
- **It can be done, but requires some 'heavy lifting'**
  - Technical capacity (often absent in developing countries)
  - Stakeholder coordination
  - Training, eduction, trust building: banks, insurers, reinsurers, farmers etc.
  - Investment in data
  - Broader risk management framework (risk reduction!) is essential
- Remote sensing is a powerful technology to support both insurance and ex post disaster relief/compensation (whether or not risk is transferred by insurance)
- (Re-)insurers are interested

Thank you !



http://siteresources.worldbank.org/INTARD/Resources/Assessment_Combind_Web_small.pdf