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The Possibility of Implementing the Area Yield Index Rice Insurance Product in Thailand

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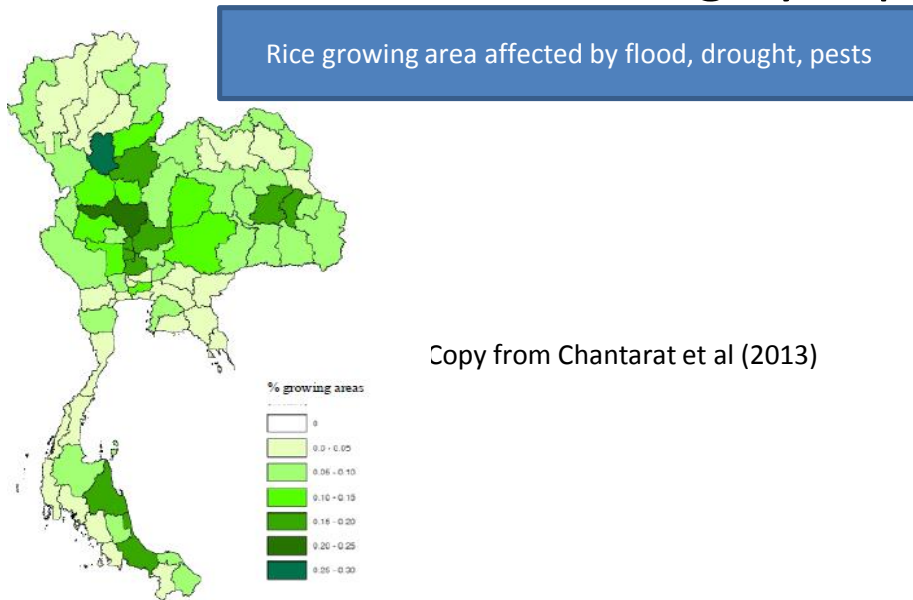
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Background

- **Rice is a major crop**
 - Total rice planted area : 11.2 Million Hectares (47% of total agricultural land use)
 - 3.7 million rice farming households rely their livelihood on rice
- Thai rice farmers are highly exposed to flood, drought, pests



Thai gov. spends 100 Million USD annually for disaster relief program to affected disaster rice farmers.

Two voluntary rice insurance schemes

	WWI for rice	Micro-Insurance for Rice (Top up to disaster relief program)
Coverage	Drought	Natural disaster (flood, drought, frost, windstorm, fire hail) Insect infestation
Types	Index : accumulated precipitation at station	Traditional : using loss assessment Top up : Receive extra payouts in addition to gov compensation
Payouts	Accumulated precipitation falls below a threshold	Planted area were in declared calamity area & verification of total loss by local authority
Implement	sold in 2010 (no gov subsidy) to provinces in NE region (rainfed area)	sold in 2011 nationwide (gov subsidized 50-60% and free provision by gov. since 2016)
# Insured farmers	1,158 (2010), 2,853 (2013)	50,000 (2011-2012)
Loss Ratio	364% in 2012	554% in 2011 (flood disaster) 116% in 2013

Challenges for Thai Rice Insurance

Weather Index Insurance

- capture drought well but cannot cover river flooding
- weather stations are limited

Micro-insurance for Rice (Top-up to Disaster Relief Program)

- Cover multi-perils
- Government criteria to declare a calamity area is not totally quantitative

Low take up & high loss ratio due to severe anti-selection problem

Area Yield Index Insurance (AYI) can be an option as yield index reflects multi-perils, reduces anti-selection & moral hazard, has lower admin & transaction costs, fast payout

Basis Risk & Take Up Insurance

Reduction in basis risk

- The area yield must be highly correlated with a farmer's yield
- Risks farmer faced should have less degree of localized perils or idiosyncratic risks



Increase in take-up

- An increase in the co-movement degree between farmer's yield & area yield would increase the take-up
- A decrease in the size of idiosyncratic risk would increase the take-up

Possibility of Implementing AYI

- Availability of time-series average yield data of defined insured units
 - Province can be used as an area unit due to the availability of 25-year provincial yield data
 - Lower disaggregate level than provincial level data for at least 15 years is not available
- The problems of basis risks of the provincial yield index would affect the take up rate.
- The main objective is to directly test the influence of the basis risk on the potential interest in buying AYI

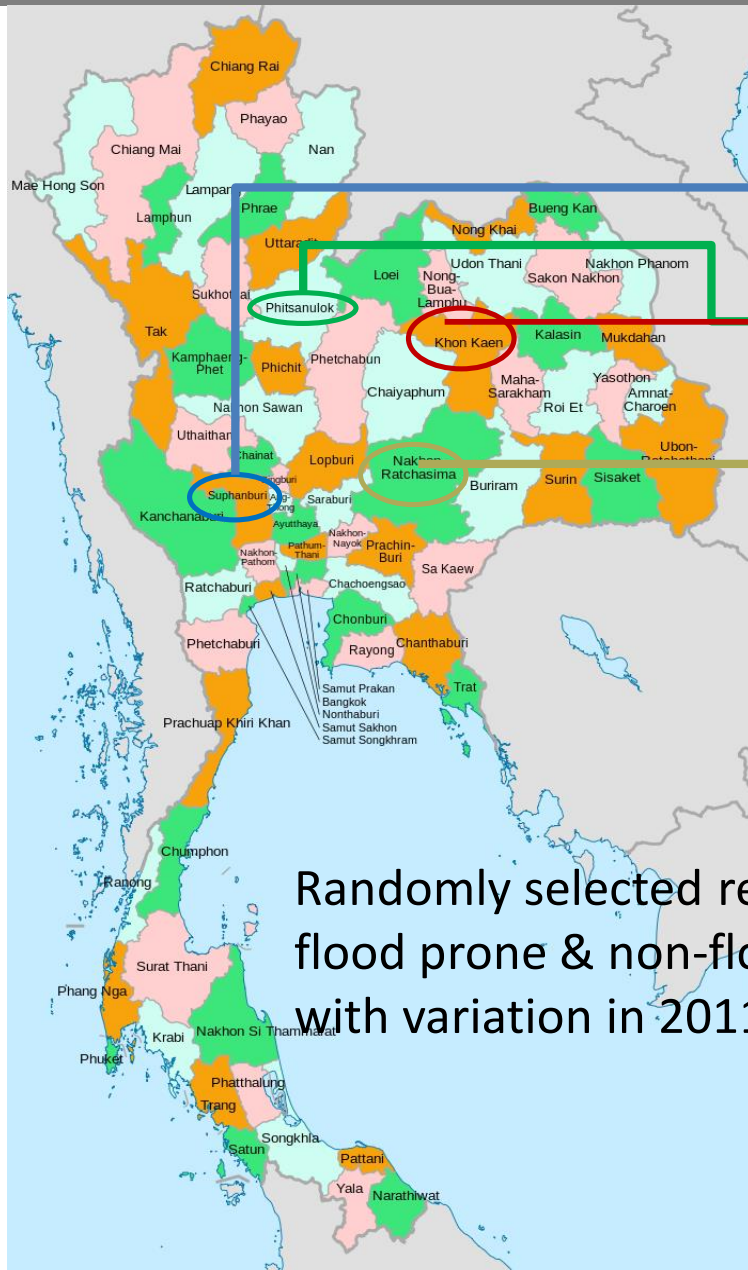
Methodology

- Design the AYI product focusing on 4 major rice production provinces, representing irrigated area & non irrigated area
- Survey 426 rice farmers in 4 provinces
 - ✓ Collect info. on agricultural and weather risks, risk management options, rice planted area, production and yield for the past 4 years
 - ✓ Explain the AYI product
 - ✓ Ask the interest in buying AYI
- Examine degree of the co-movement & size of idiosyncratic risk
- Estimate factors affecting decision to buy the AYI (probit model)

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Data



Region	Province	N	Feature
Central	Supanburi	104	<ul style="list-style-type: none"> • 15% of planted area
	Pitsanulok	122	<ul style="list-style-type: none"> • Mostly irrigated • Top-up insurance program
North-eastern	Khon Kaen	104	<ul style="list-style-type: none"> • 20% of planted area
	Nakorn Ratchasima	96	<ul style="list-style-type: none"> • Mostly rainfed • Khon Kaen (WWI+Top-up) • Nakorn Ratchasima (Top-up)
	Total	426	

Randomly selected respondents in flood prone & non-flood prone areas with variation in 2011 flood exposure.

Characteristics of Rice Farming Respondents

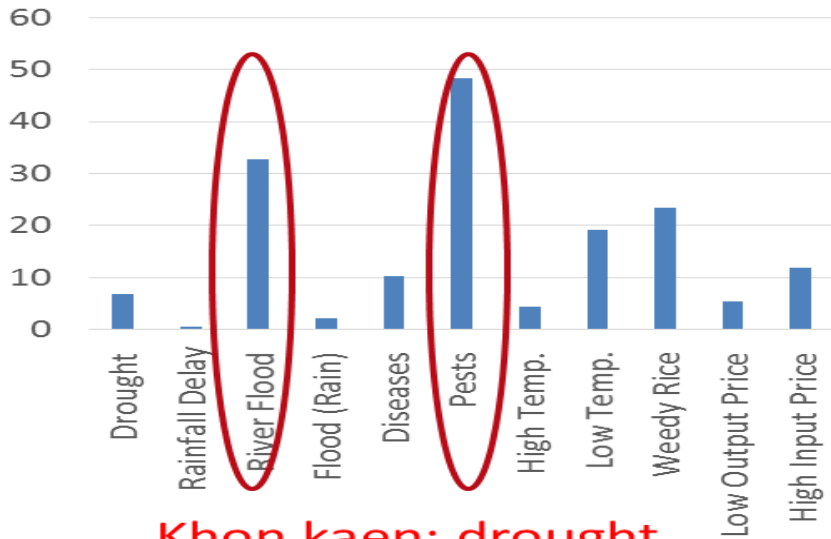
- Had average age of 50 with 30 years of experience in rice farming
- Had attained a level of education less than or equal primary education
- Supanburi & Pitsanulok (Central) rice farming households are relatively richer than Khonkaen & Nakorn Ratchasima (NE) farming households and rely more on rice farming income.

	Central		NE	
	Supanburi	Pitsanulok	Khonkaen	Nakorn Ratchasima
Net rice income (\$/yr)	10,297	8,588	2,654	3,426
% of total income	72.3	81.7	38.1	47.2

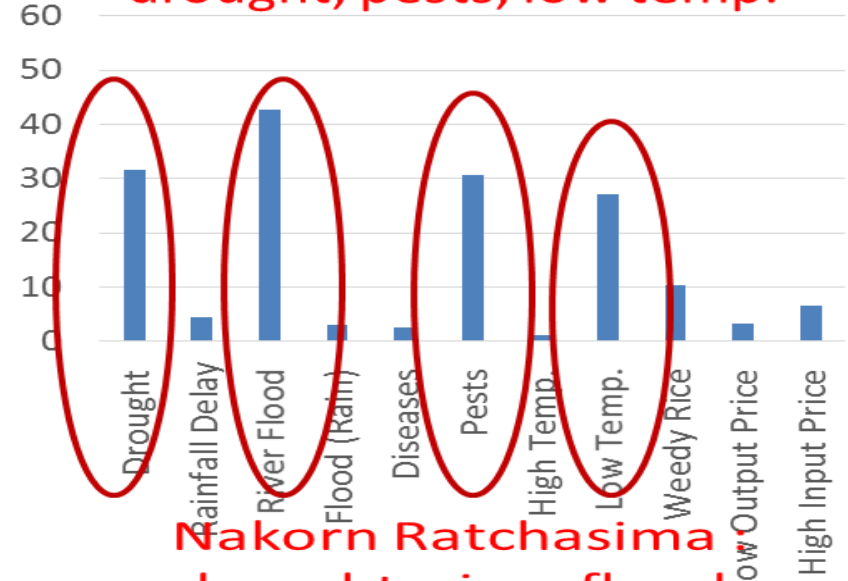
- The average size of paddy land per farmer was less than 30 Rai (4.8Ha) .
- Most of Khonkaen & Nakorn Ratchasima rice farmers are relatively small-scale.
- Only few farmers bought the top-up & WWI insurance.

Top two risks that concerned them most:
Rice farmers in different provinces had different risk perceptions

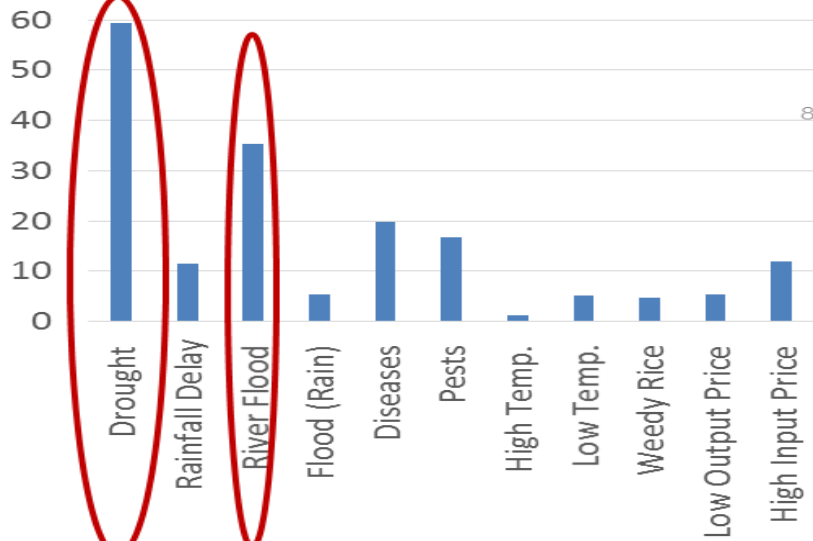
Supanburi: Pests, River Flood



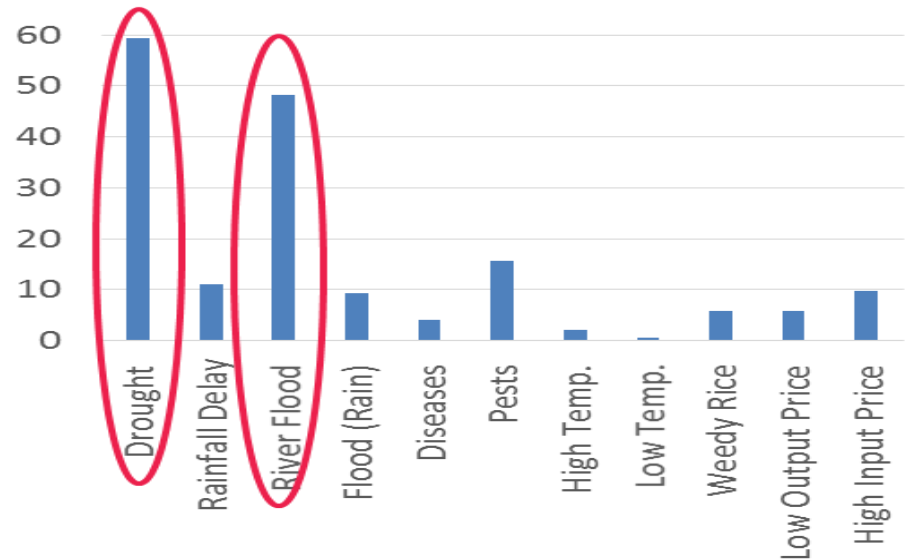
Pitsanulok: River flood, drought, pests, low temp.



Khon kaen: drought, river flood

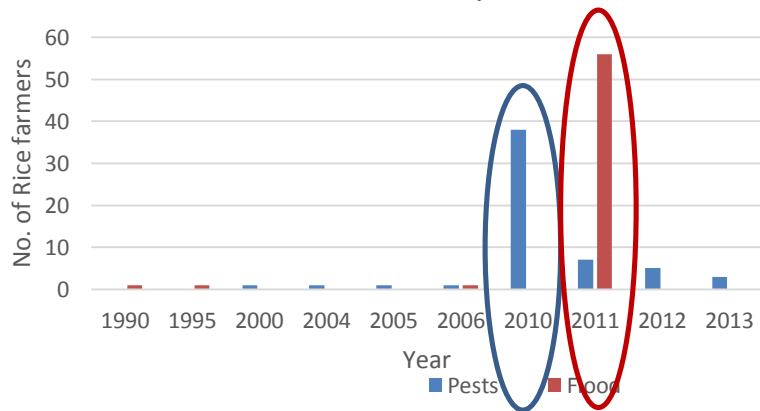


Nakorn Ratchasima: drought, river flood

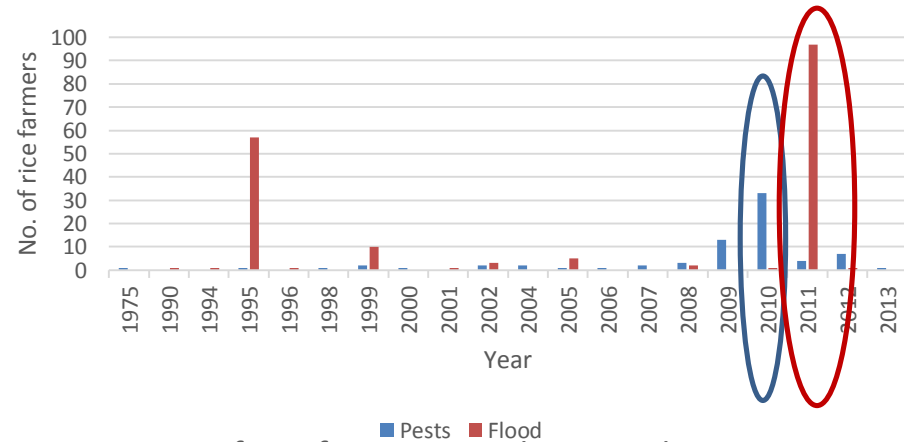


Major respondents experience flood in 2011. Pests in 2010 occurred in central and drought in 2012 occurred in NE was the second common

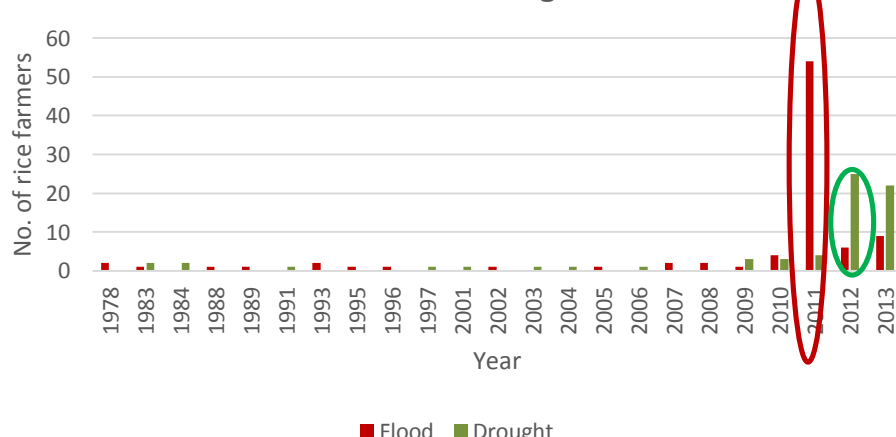
No. of rice farmers in Supanburi experienced flood and pests



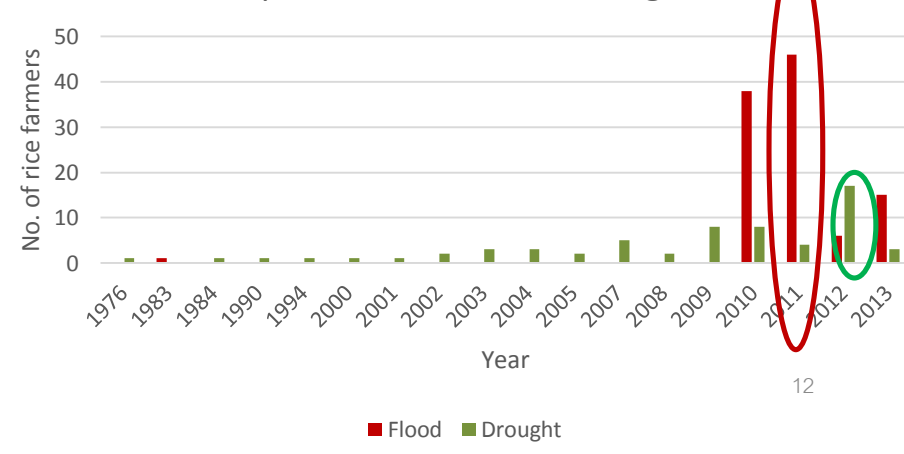
No. of rice farmers in Pitsanulok experienced flood and pests



No. of rice farmers in Khon Kaen experienced flood and drought



No. of rice farmers in Nakorn Ratchasima experienced flood and drought



Flood & pests significantly reduced farmers' average yields

	2011 Flood: all 4 provinces	2012 Drought: NE	2010 Pests: Central
Affected farmers	253 farmers (Pit 38%, other provinces 18-22%)	42 farmers (21%)	71 farmers
Duration (Days)	10-180 days	30-90 days	7-120 days
Avg. affected planted area/hh.	86%	92%	85%
Avg. loss in rice yield/hh	462 kg/Rai (2.9 tons/Ha) Central: 546 kg/Rai 3.4 tons/ha NE: 333 kg/Rai 2.1 tons/Ha	212 kg/ Rai (1.3 tons/ha)	405 kg/Rai (2.5 tons/ha)
Avg. loss in income/hh	146,552 Baht (Central: 184,523) NE:88,457)	75,364 Baht	108,102 Baht

Coping Strategies : Borrowing funds from the Bank of Ag. (BAAC) was a dominant risk coping strategy

	2011 Flood: all 4 provinces (N=253)	2012 Drought: Khon kaen, Nakorn Ratchasima (N = 42)	2010 Pests: Sumpunburi, Pitsanulok (N=71)
Borrowing from BAAC	133 (53.0%)	17 (40.5%)	22 (31.0%)
Help from relatives	36 (14.2%)	8 (19.0%)	5 (7.0%)
Reduced food consumption	49 (19.4%)	8 (19.0%)	11 (15.5%)
Received insurance payouts	13 (5.1%)	5 (11.9%)	0
Additional labor work	23 (9.1%)	4 (9.5%)	1 (1.4%)
Selling asset	11 (4.4%)	1 (2.4%)	2 (2.8%)
Postpone buying asset	14 (5.5%)		

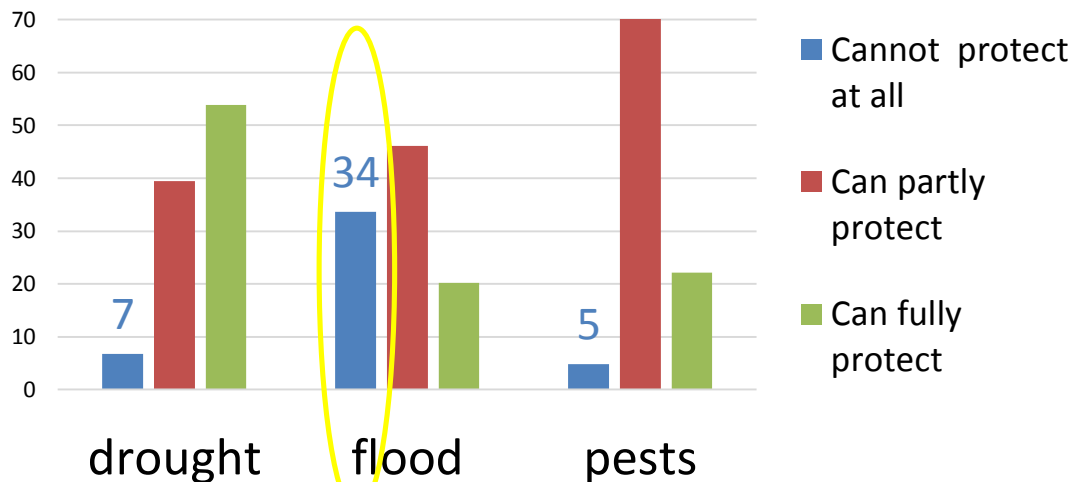
Major farmers experienced debt rehabilitation & received gov. compensation in the case of flood, drought, but not for pests

	2011 Flood: all 4 provinces (N=253)	2012 Drought: Khon kaen, Nakorn Ratchasima (N = 42)	2010 Pests: Sumpunburi, Pitsanulok (N=71)
Debt moratorium	134 of 206 (65.0%)	14 out of 31 (45.1%)	15 out of 48 (21%)
Government compensation	156 (62.1%)	24 (57.1%)	19 (26.8%)
-is sufficient	135 (86.5 %)	23 (95.8%)	18 (94.7%)

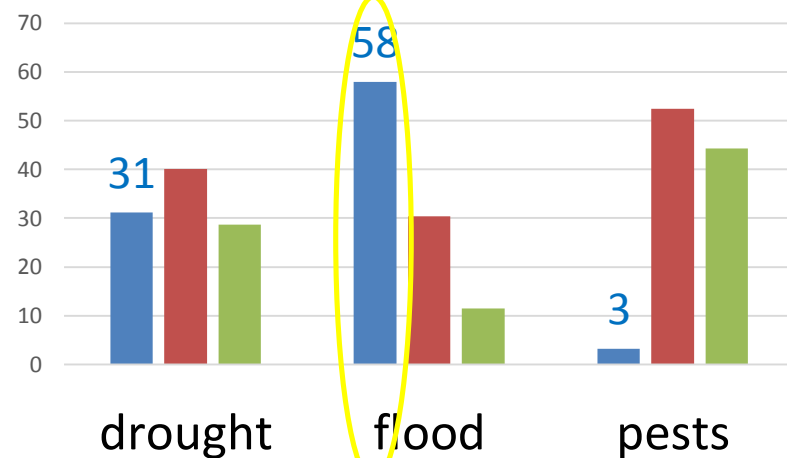
Farmer's Judgment on Ability to Protect from Flood, Drought and Pest Risks

Risks: higher respondents judged that they cannot protect themselves at all from flood risks

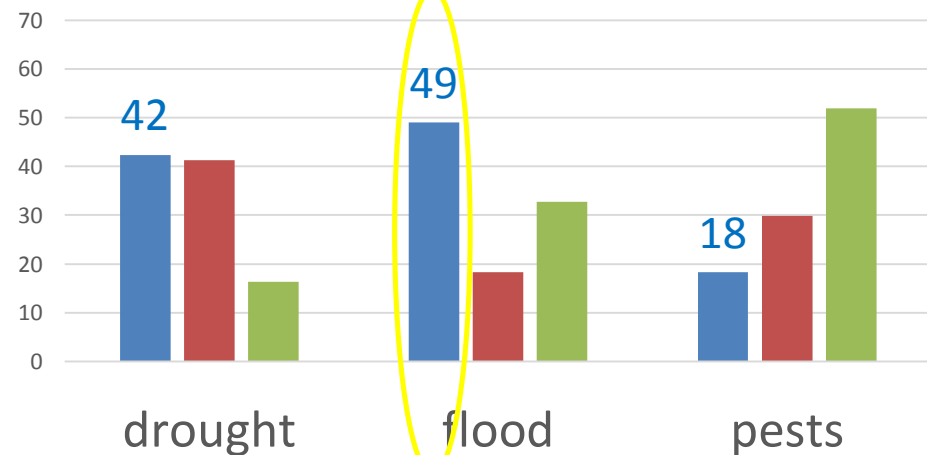
Supanburi farmers



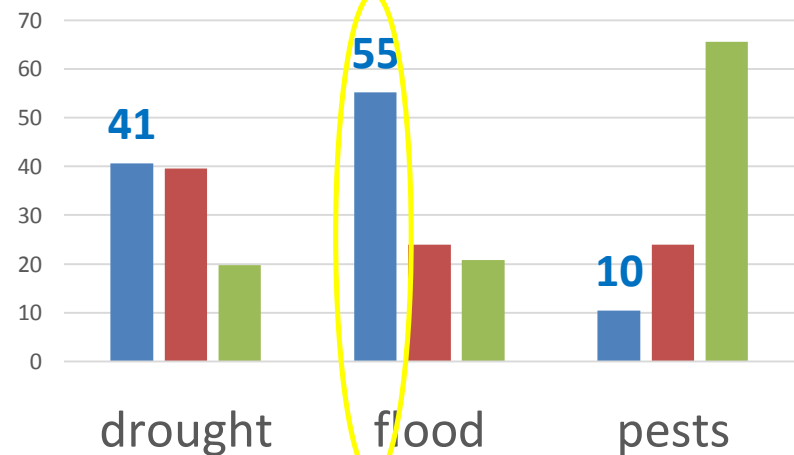
Pitsanulok farmers



Khon Kaen farmers



Nakorn Ratchasima farmers

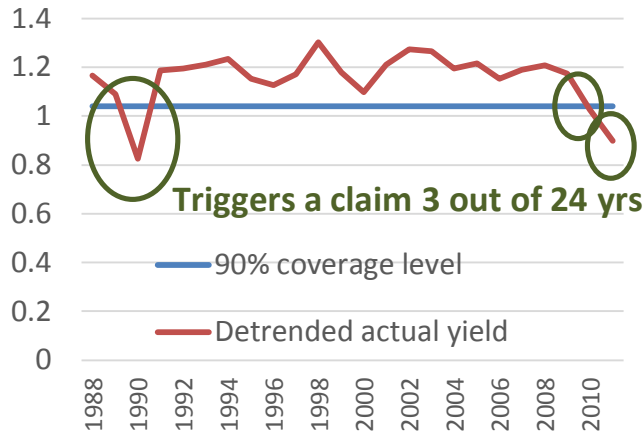


AYI Design

- The detrended provincial yield falls below the insured yield (90 % of the average detrended provincial yield in the past 24 years)

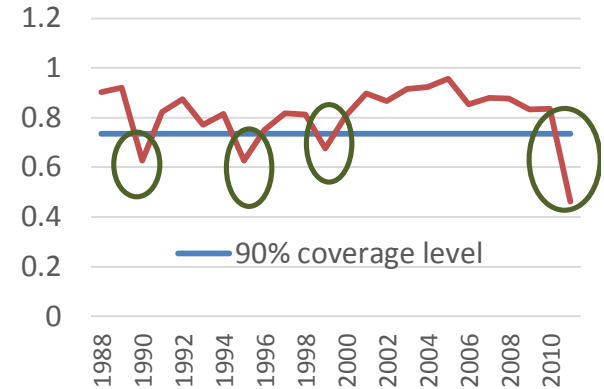
$$\mu_t \text{ detrend} = \dot{\mu}_t + (T - t)\hat{b}$$

Supanburi Province

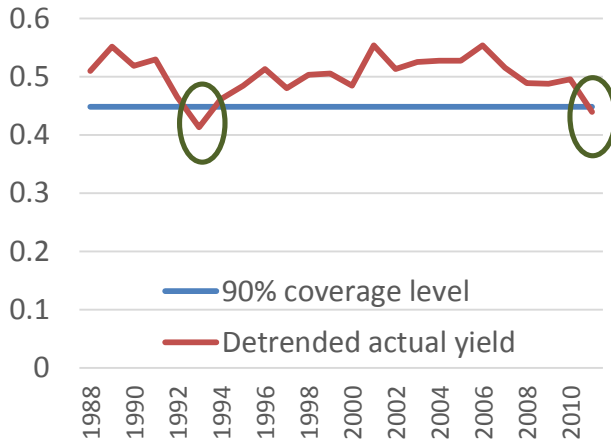


Central area
Irrigated area

Pitsanulok Province

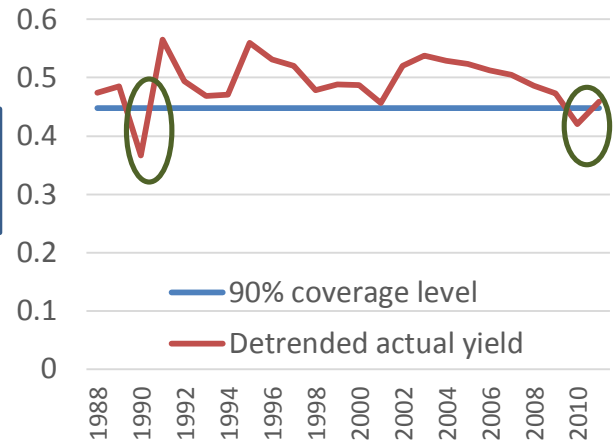


Khonkaen Province



NE area
Rainfed area

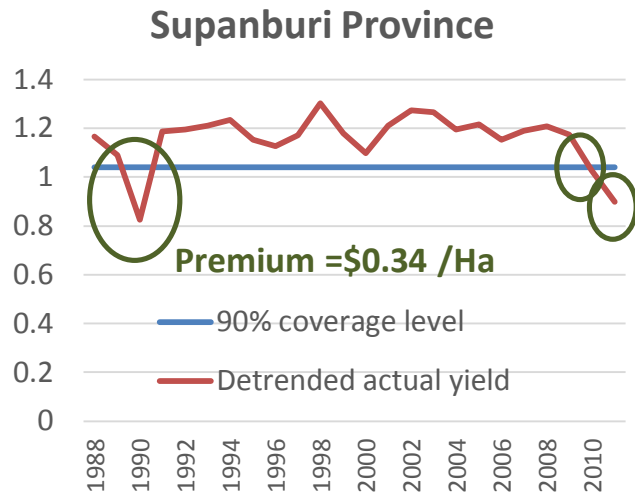
Nakornratchasima Province



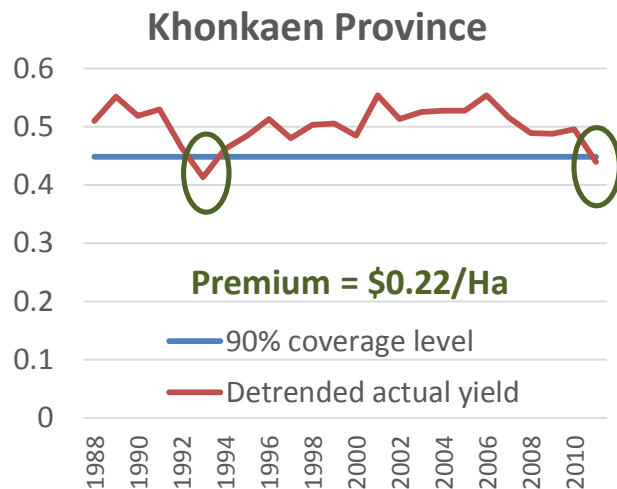
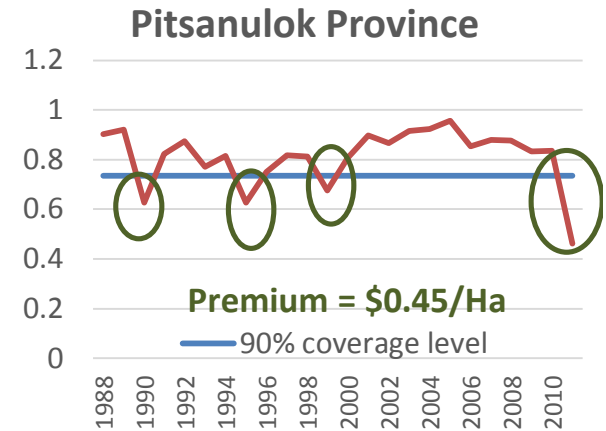
Given sum insured of \$5.4/ha

(same amt. as the current top up program)

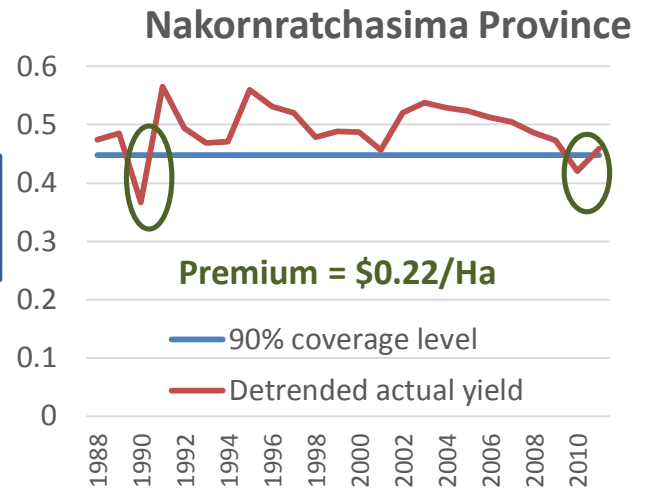
- Premium cost = the prob. of yield shortfall below the insured level * the sum insured * subsidized premium rate (50%)



Central area
Irrigated area



NE area
Rainfed area



After explaining the AYI Concept

- **75% understood the AYI concept** but **25% had difficulty in understanding** that he won't receive compensation when the farmer's individual crop suffers from perils, yet the provincial's e yield remain stable
- **39% were interested in buying the AYI product.** Reasons were a high chance that the provincial yield data would fall below the criteria, the provincial yield data is compatible with the individual yield.
- 61% not buying. Reasons were the low level of yield criteria to pay for compensation, bad experiences with the top up program, and not understanding the AYI.

Estimated degree of the co-movement & size of idiosyncratic risk

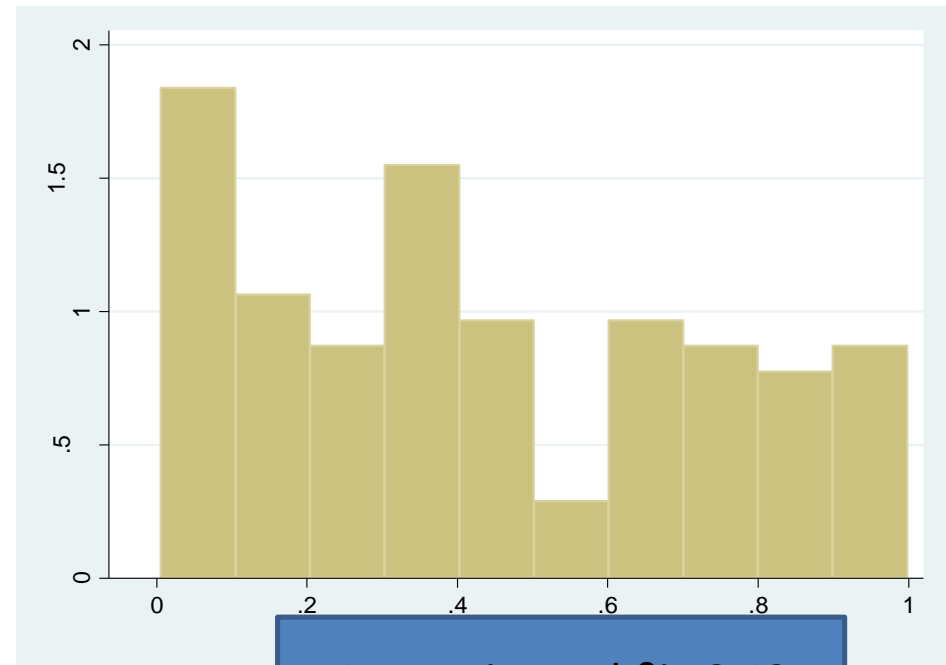
$$y_i - \bar{y}_i = \beta_i(\mu - \bar{\mu}) + e_i$$

$\beta_i(\mu - \bar{\mu})$: covariate risk

e_i : idiosyncratic risk

$$\beta_i = \frac{\text{cov}(\mu - \bar{\mu}, y_i)}{\text{var}(\mu - \bar{\mu})} \text{ measures}$$

how closely a farmer's yield follows the average yield.



Avg. estimated $\beta_i = 0.42$

Yield variation	Covariate risk	Idiosyncratic risk
	46%	54%

Comparison between respondents buying AYI vs not buying

Independent Variables	Not buying		Buying		Total	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
The degree of co-movement (Bi)	0.40	0.22	0.44	0.24	0.42	0.16
The degree of idiosyncratic (SD of the ei)**	93	4.93	75	4.91	87	3.63
Understanding of AYI*	0.74	0.03	0.80	0.03	0.76	0.02
Differences between the losses from AYI and actual loss (0= no difference, 1= difference)***	0.90	0.02	0.80	0.03	0.86	0.02
Level of trust of provincial yield (0 =no or low trust 1= high trust)***	0.78	0.03	0.89	0.02	0.82	0.02
Numbers of perils* (1=>1 type)	0.25	0.03	0.32	0.04	0.28	0.02
The number of year that farmer perceived severe flood in future 10 years***	2.11	0.12	2.82	0.18	2.39	0.10
Effectiveness of exante risk management strategy (Interaction term between dummy variables representing adoptinting at least one risk management strategy and that representing farmer's judgement that can totally protect from risk)	0.06	0.01	0.04	0.02	0.05	0.01
Sufficiency of government compensation (0= not sufficient/not receiving, 1= sufficient)***	0.52	0.03	0.39	0.04	0.47	0.02
Having savings (0 =not having, 1=have savings)*	0.78	0.03	0.89	0.02	0.82	0.02
The 10% poorest household dummy (1= poorest households)	0.11	0.10	0.08	0.02	0.10	0.01

Summary of empirical results

- The degree of the co-movement between farmer's individual yield and provincial yield is not significant in explaining the insurance take up
- The reduction in the degree of idiosyncratic risk results in increasing the likelihood to join the AYI (ME is relatively low).
- The probability of joining the AYI is higher for rice farmer that
 - has perception that there is no discrepancy between the loss measured from provincial yield and actual yield
 - has high level of trust of provincial yield.
 - understanding the concept of AYI particularly the basis risk
- A farmer understanding the concept of AYI particularly the basis risk would have a higher probability of joining AYI than that misunderstanding the concept.

Marginal Effects of the Independent Variables to the Probability of potential joining the AYI

Independent Variables	Marginal Effects	S.E.	Marginal Effects	S.E.	Marginal Effects	S.E.
The degree of co-movement (Bi)	0.004	0.010				
The degree of idiosyncratic (SD of the ei)	-0.0011**	0.000	-0.0011**	0.000	-0.0010**	0.000
Understanding of AYI			0.107*	0.064	0.106*	0.064
Differences between the losses from AYI and actual loss (0= no difference, 1= difference)			-0.160*	0.091		
Level of trust of provincial yield (0 =no or low trust 1= high trust)					0.229***	0.062
Numbers of perils (1=>1 type)	0.120*	0.066	0.120*	0.067	0.103	0.067
The number of year that farmer perceived severe flood in future 10 years	0.026*	0.015	0.026*	0.015	0.029*	0.016
Effectiveness of exante risk management strategy (Interaction term between dummy variables representing adoptinting at least one risk management strategy and that representing farmer's judgement that can totally protect from risks)	-0.175*	0.103	-0.176*	0.105	-0.160	0.107
Sufficiency of government compensation (0= not sufficient/not receiving, 1= sufficient)	-0.121**	0.059	-0.118**	0.059	-0.118**	0.059
Having savings (0 =not having, 1=have savings)	0.164***	0.060	0.144**	0.062	0.151**	0.061
The 10% poorest household dummy (1= poorest households)	-0.030	0.108	-0.048	0.107	-0.013	0.112

Policy Implication

- The provincial yield index is not feasible to implement due to low degree of co-movement & higher sizes of idiosyncratic risks
- Improve the quality of estimating yield data at the smaller units
 - The rice production/yield data in the insured unit is less heterogeneous
 - Increase the degree of co-movement
 - Make farmers more trust in provincial yield data and perceived that no discrepancy between the losses measured from provincial yield and actual yield.
 - Increase the take-up rate