



Agriculture in Transition and Implications for Agricultural Extension for Small Farms in China

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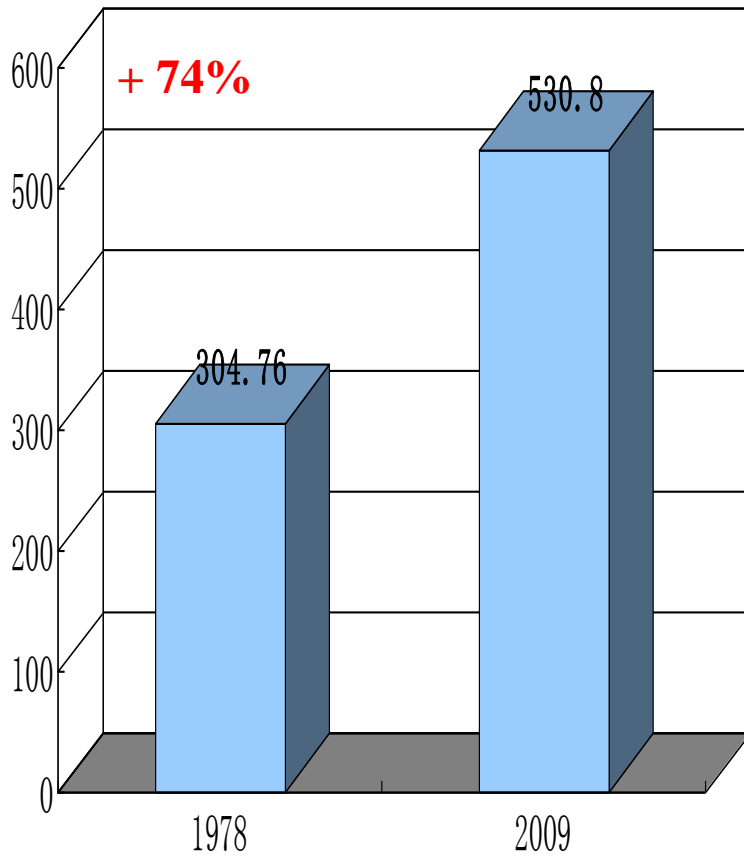
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Chinese Academy of Sciences**

Outline of Presentation

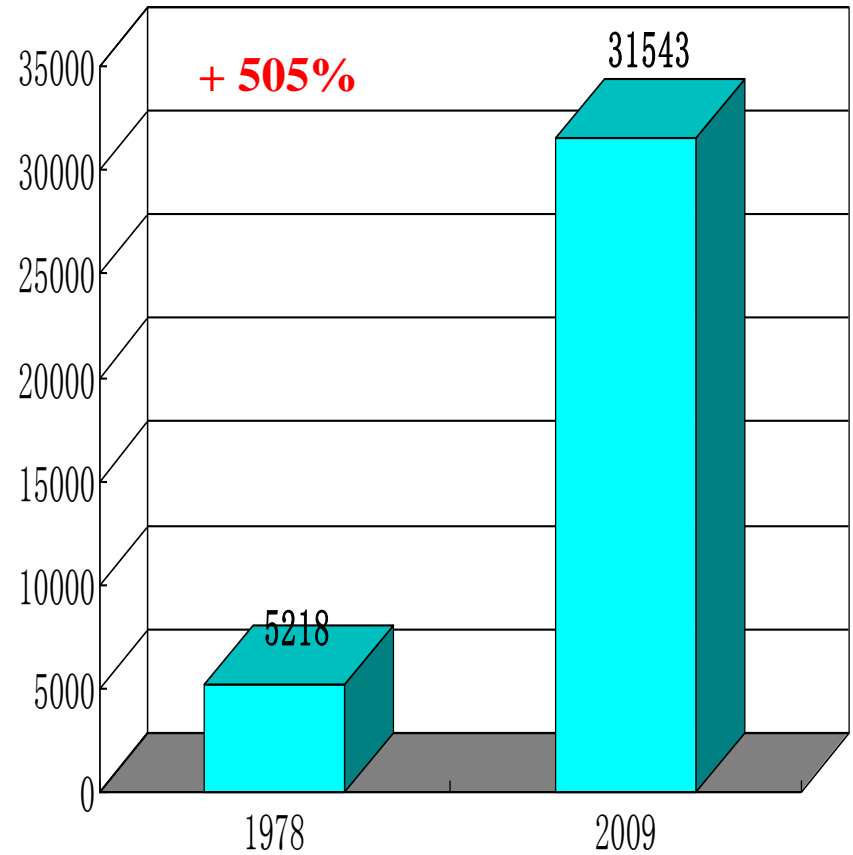
- **Agriculture in Transition**
- **Challenges of Agricultural Extension**
- **Concluding Remarks**

Production of grains

Grain (million tons)

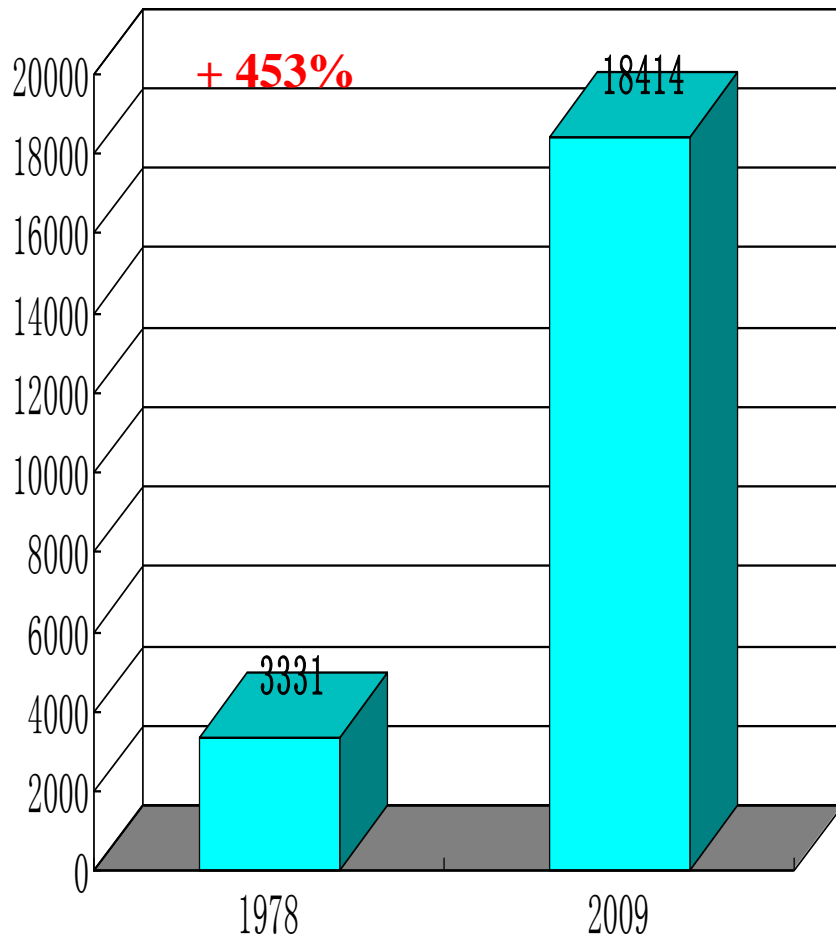


Oil crops (1000 tons)

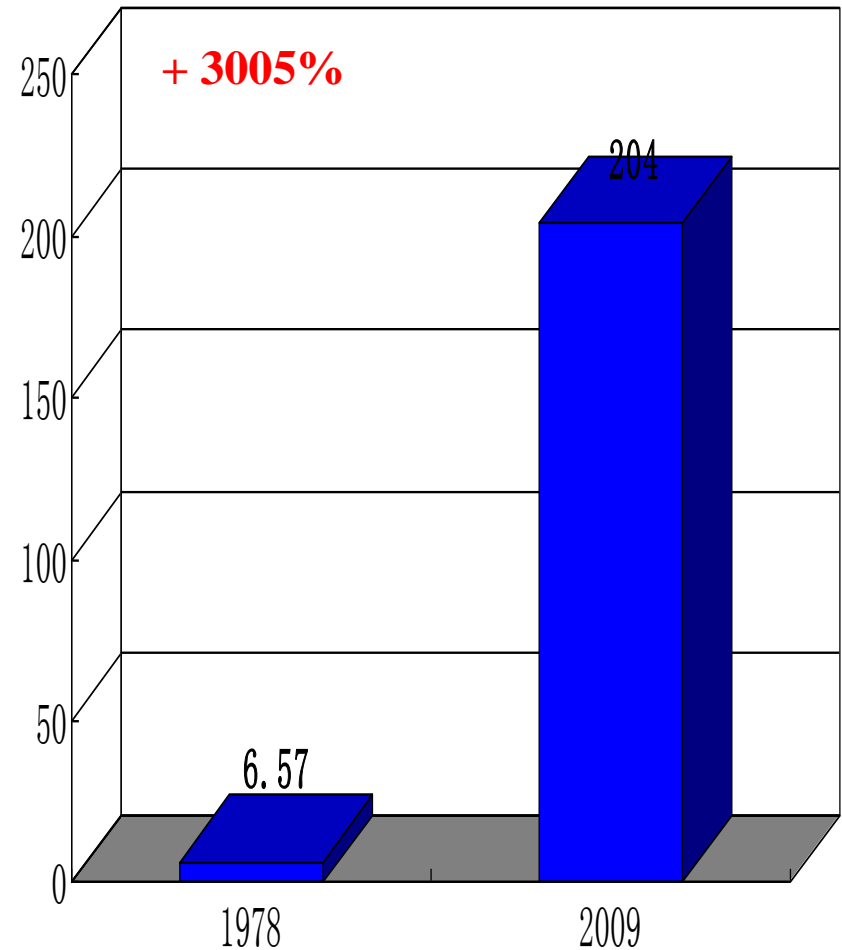


Vegetables and fruits

Vegetable area (1000 ha)

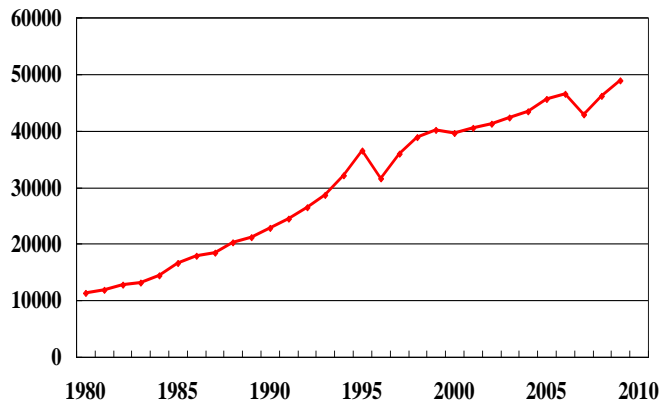


Fruit outputs (million tons)

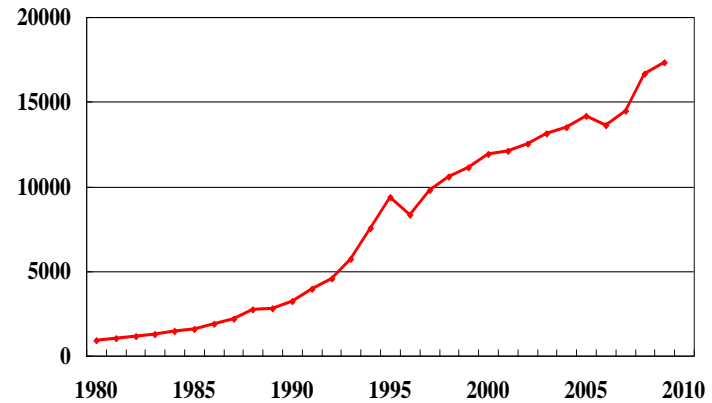


Meat production (1000 tons)

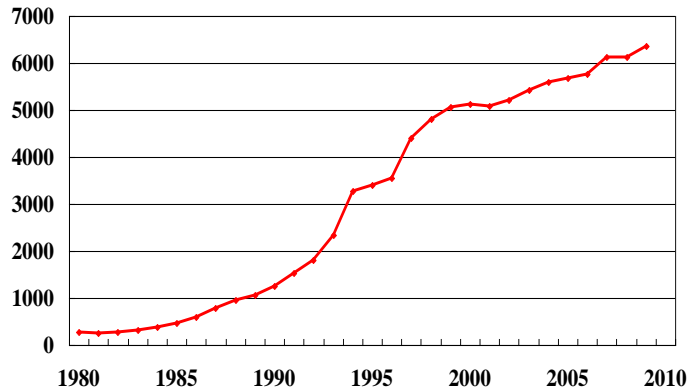
Pork



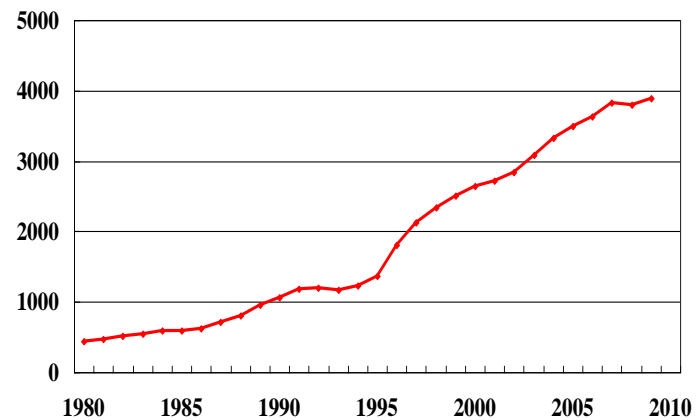
Poultry



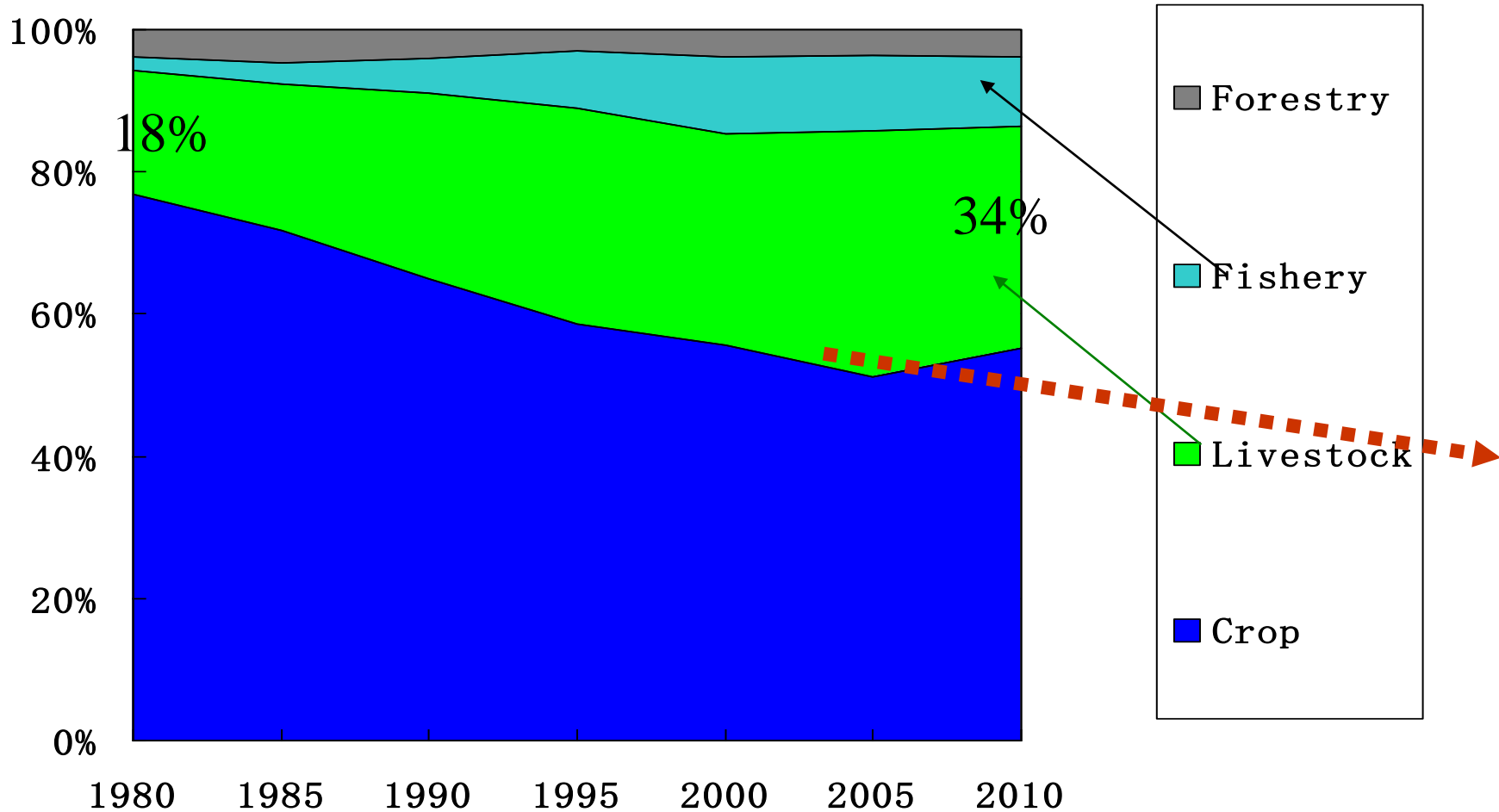
Beef



Mutton

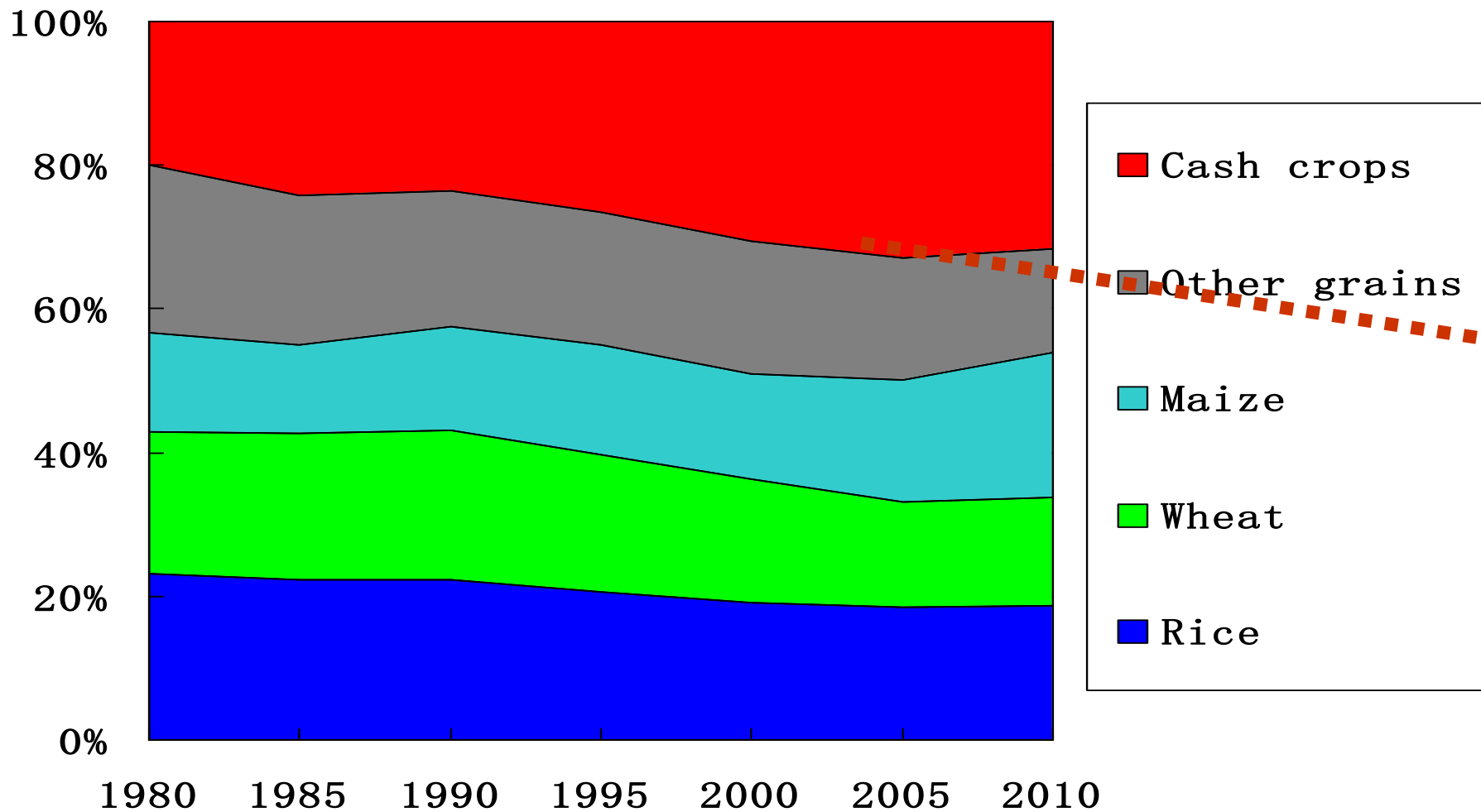


Shares of output values within agricultural sector, 1980-2010, (%)



Within agriculture: falling the shares of crops, rising the shares of livestock and fishery

Shares of crop areas, 1980-2010, (%)



Rising horticulture/other cash crops...

Agriculture in Transition and Current Extension Efforts

Transition:

Extension effort

■ Output in transition

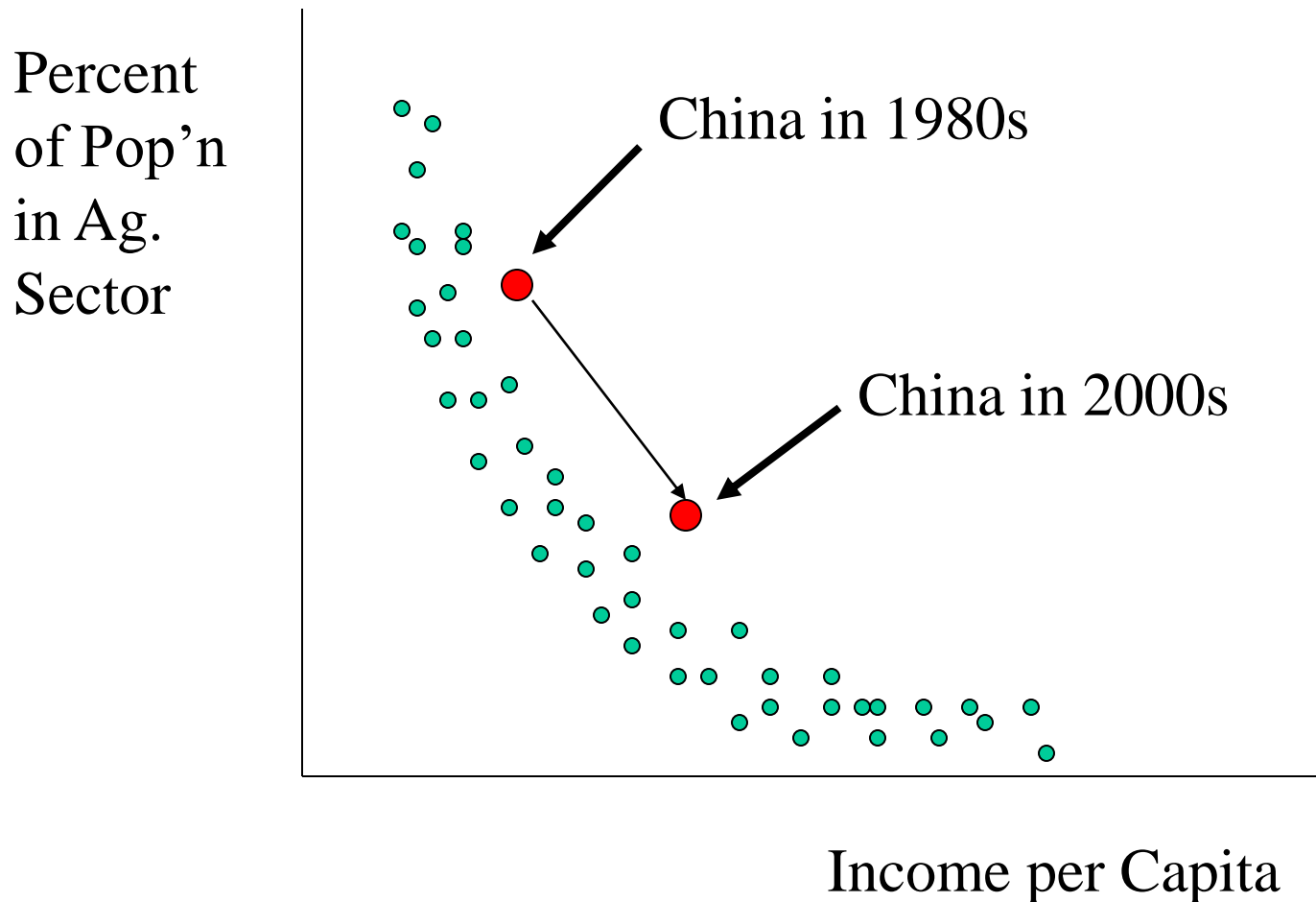
- | | |
|----------------------------|-----|
| - Grain + | +++ |
| - High-value crops +++ | + |
| - Rising animal sector +++ | + |

Agriculture in Transition

- **Output in transition**
- **Input in transition**
 - **Labor**
 - **Land**
 - **Capital**

Here I use labor in transition as an example...

China's progress – moving rapidly towards modernization



Youth: Moving out of agriculture

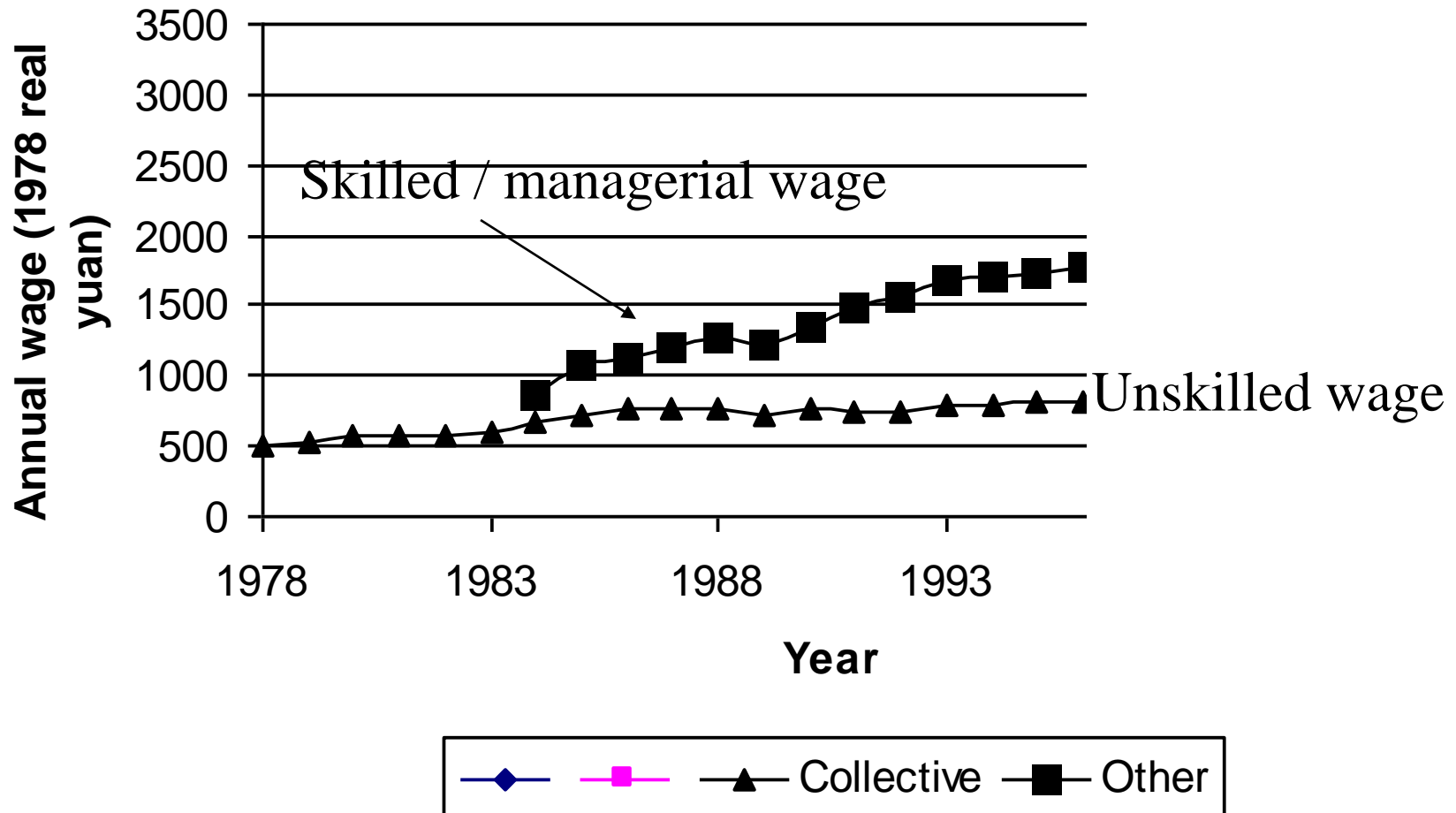
Off-farm employment (%)

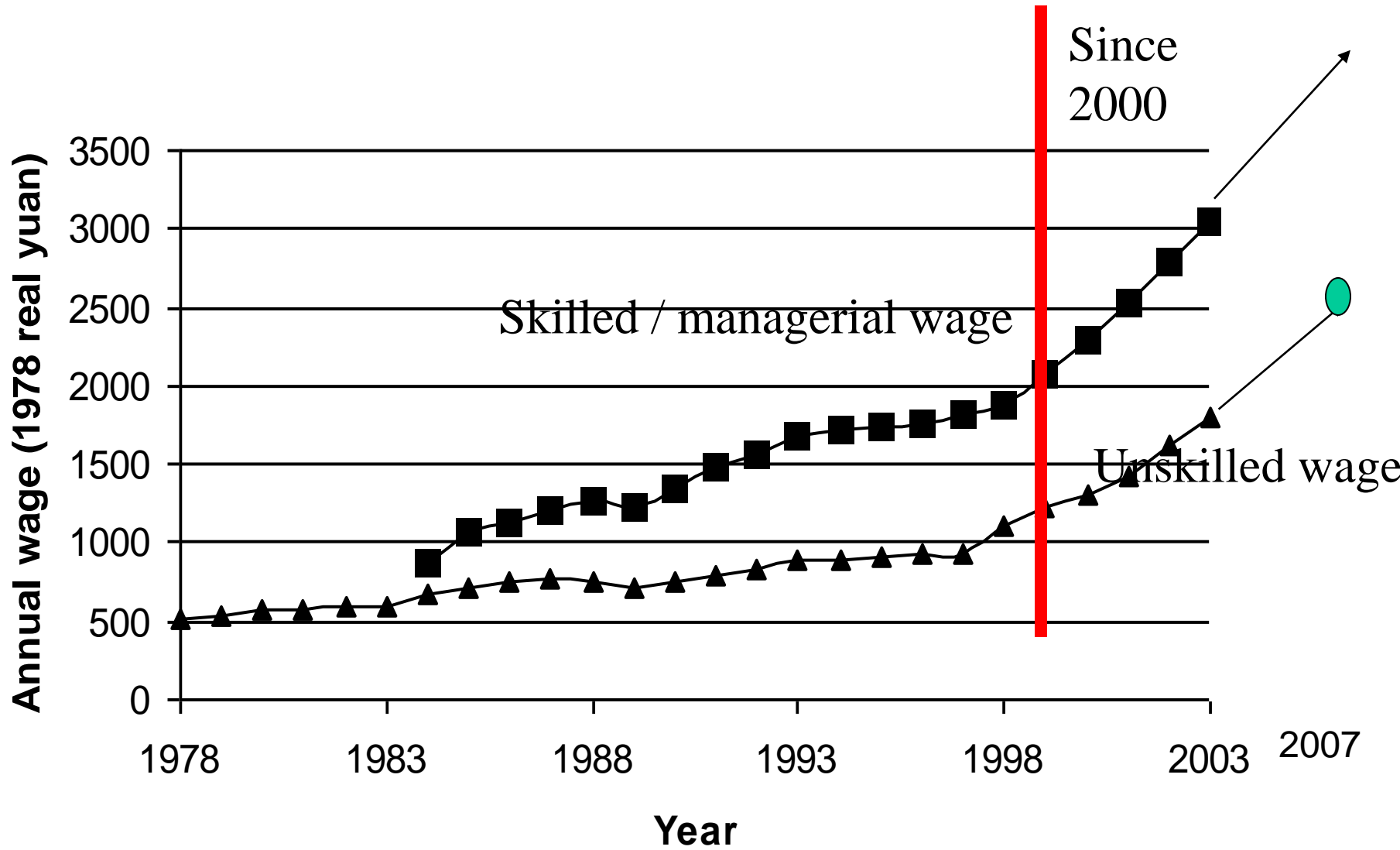
Ages	1990	2000	2008
16-20	23.7	75.8	95
21-25	33.6	67.2	
26-30	28.8	52.5	
31-35	26.9	47.6	
36-40	20.5	43.3	
41-50	20.8	37.6	

Agriculture: aging + feminization → technology?

Source: CCAP's surveys

During this process ... what is happening to wages?





Our work has shown that wages are rising fast ... especially in recent years ...

Rising wage is going to have significant implications to agricultural extension service

Implications:

- Mechanization
- Custom service
- **Chemical use**
- Other tech...

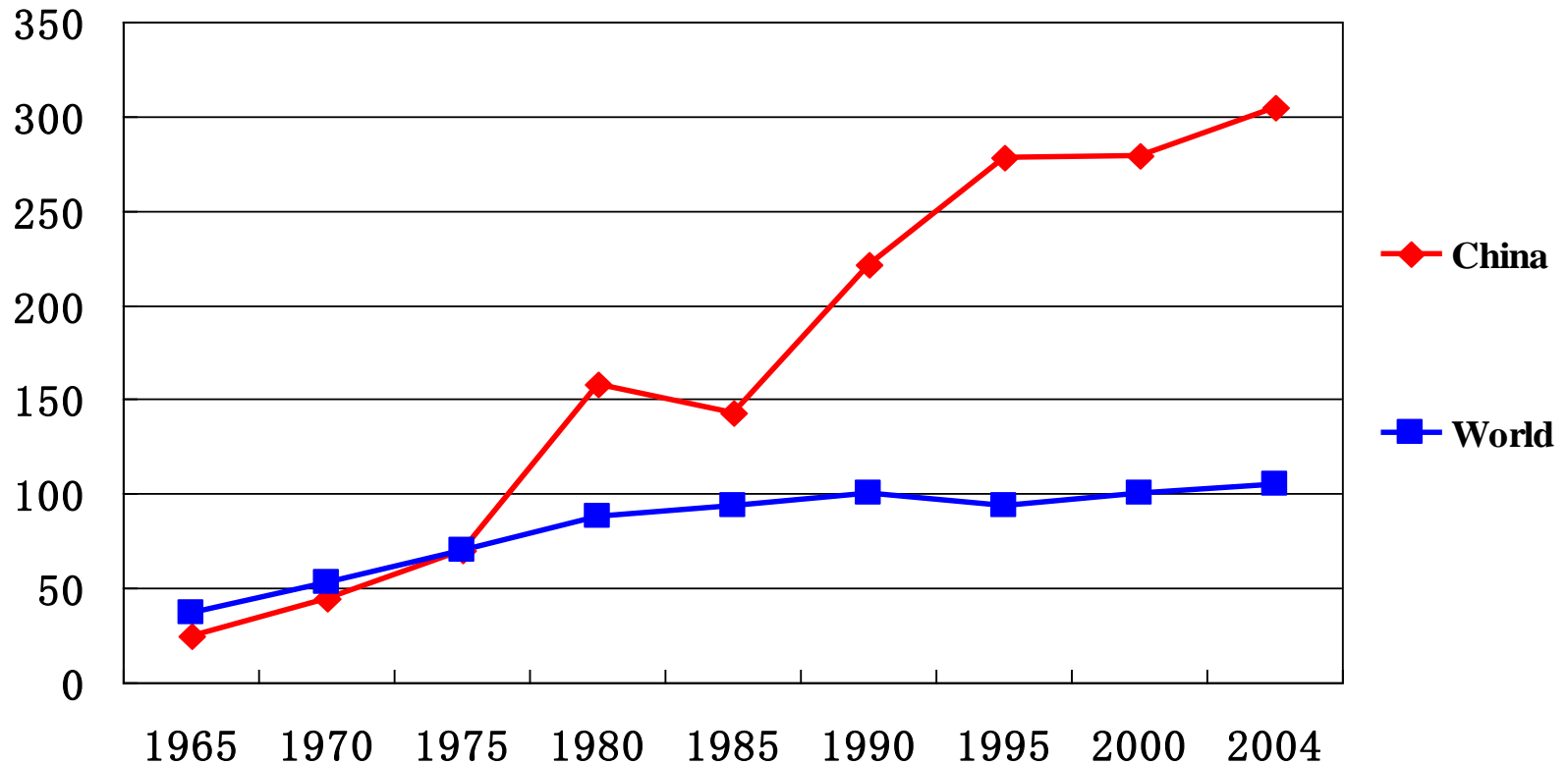
Extension effort

++

+

0

Fertilizer use intensity (kg/ha)



4th highest in the world: Japan → Korea → Holland → China

Some Facts in China, 2007

- **Agriculture and the agro-chemical industries:**
 - **15%** of fossil energy use
 - **15-18%** of GHG emission
- **Emission from N-fertilizer production + use:**
 - **30%** of agriculture
 - **5%** of total GHG emissions in China

Fertilizer N “overshoot”

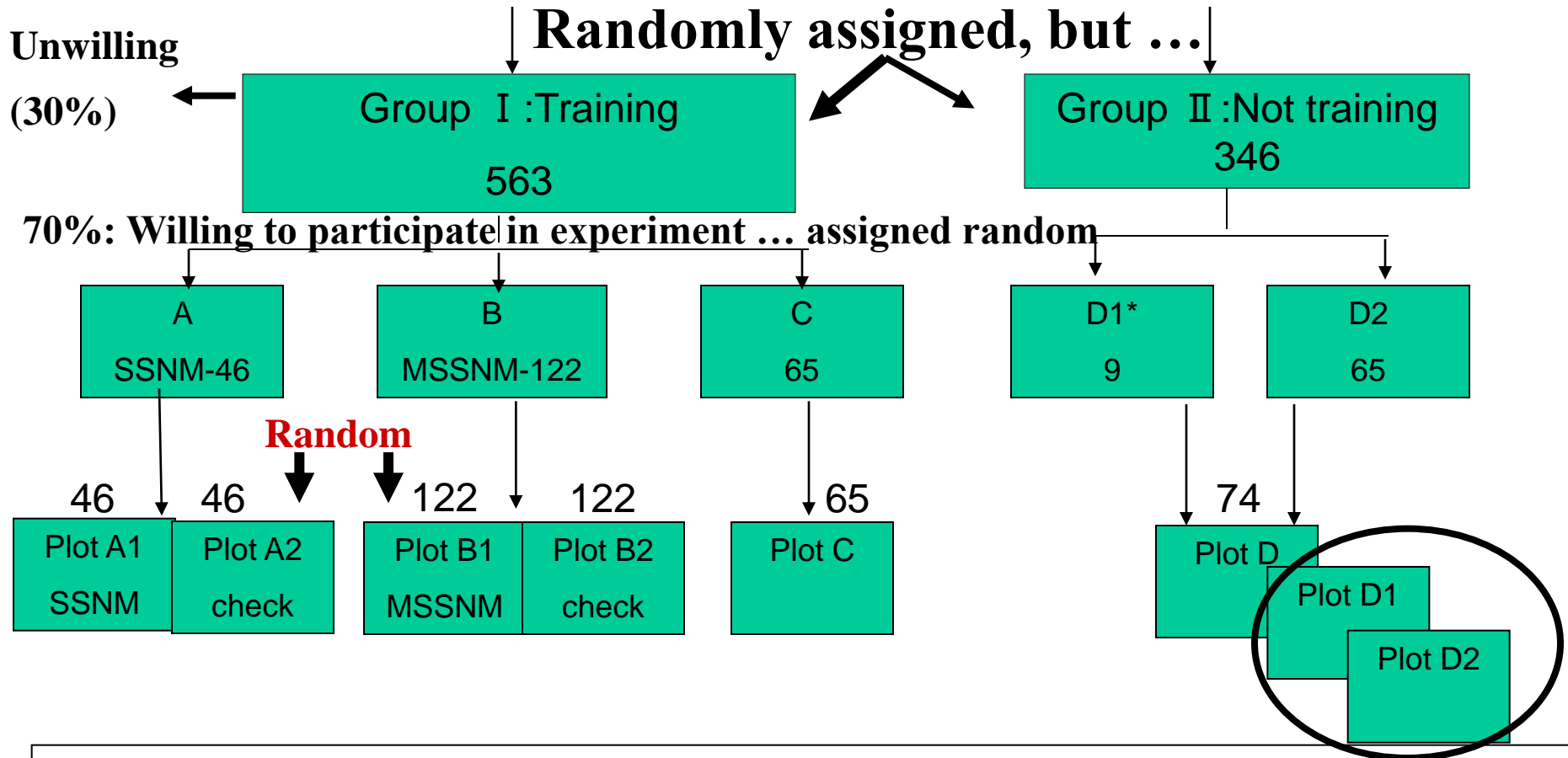
	Fertilizer N applied kg ha ⁻¹		Excess %
	Optimum for region	Farmers average	
Rice (Taihu)	200	300	50
Wheat (Taihu)	153	250	63
Wheat (NCP)	128	325	154
Maize (NCP)	158	263	66

Ju *et al* (2009) *PNAS* **106**, 3041-3046

Design of experiments (2003/2004): 4 types of farmers in 3 provinces

- **Type A**
 - **Training + scientist-guided/extension agent monitored experiment**
- **Type B**
 - **Training + no monitored experiment**
- **Type C**
 - **Training only**
- **Type D**
 - **No Training / no experiment**

Experiment sample structure

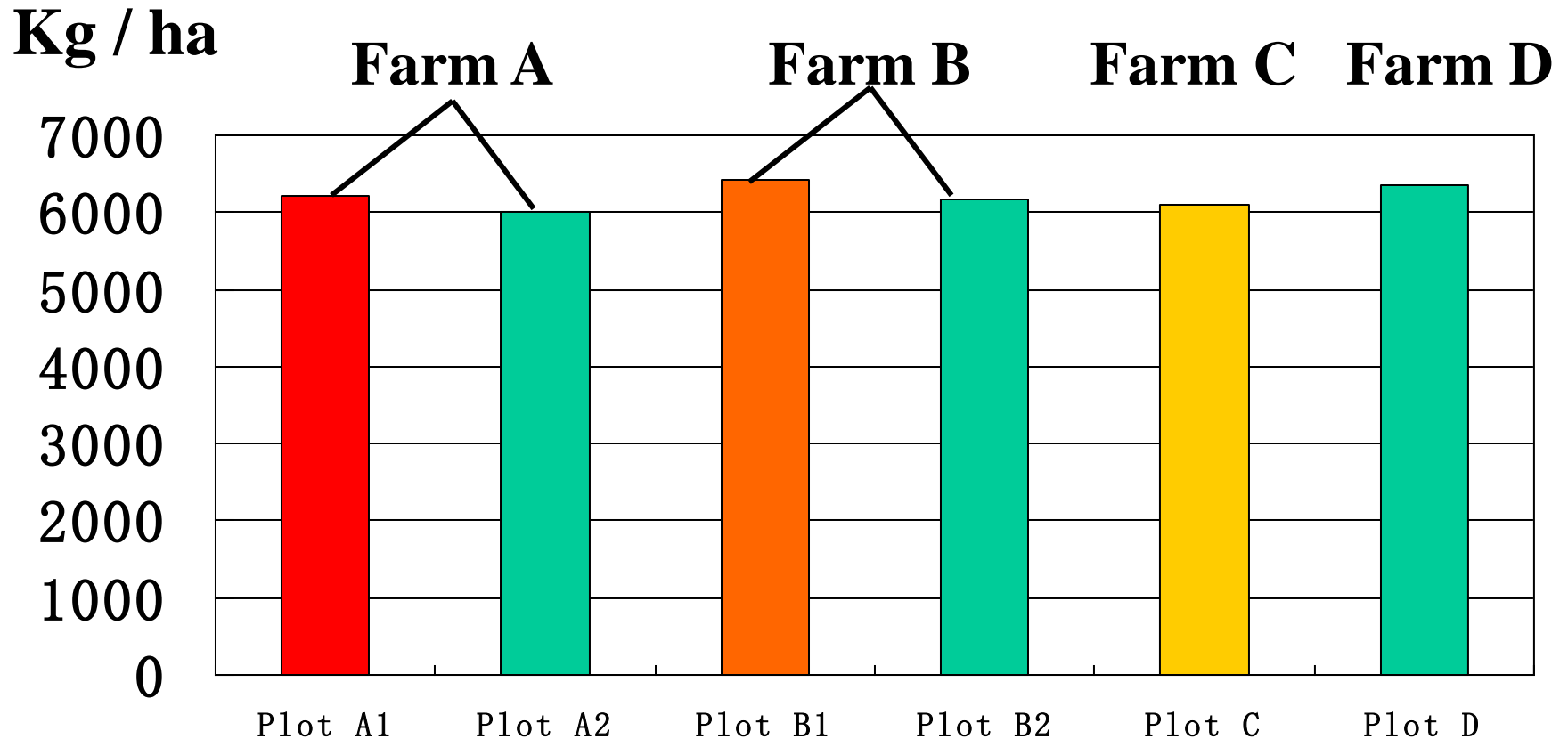


Worry about “contamination” inside the village ... non-trainees saw what trainees were doing ... and changed their behavior

...

So we have randomly selected neighbors / second neighbors ... no difference in fertilizer use/ha or yields between D and D1/D2

Yield Effects of SSMN



Statistical Tests Show that there are no differences among yields ... BUT farmers significantly reduced fertilizer use on plots A1/B1

Table 7. Impact of Technology on N-fertilizer use quantities in rice production in China.

	The quantity of N-fertilizer use			
	Linear model		Log model	
	Coefficient	T value	Coefficient	T value
Technology training course	13.345	(0.84)	0.147	1.55
A1 plot	-52.378	(3.45)***	-0.35	3.86***
A2 plot	-10.880	(0.72)	-0.096	1.05
B1 plot	-38.277	(2.66)***	-0.27	3.11***
B2 plot	-11.384	(0.79)	-0.106	1.23
C plot	-22.652	(1.53)	-0.18	2.04**
House	-2.501	(0.63)	-0.010	0.41

•**18%** -- training only

•**27%** -- training + modified technologies

•**35%** -- training + intensive guide/strict use of tech

Indica rice (yes=1)	-4.155	(0.58)	-0.014	0.22
Indica rice (yes=1)	7.795	(0.67)	0.053	0.75
Constant	232.908	(16.30)***	7.497	74.79***
Observations	475		475	

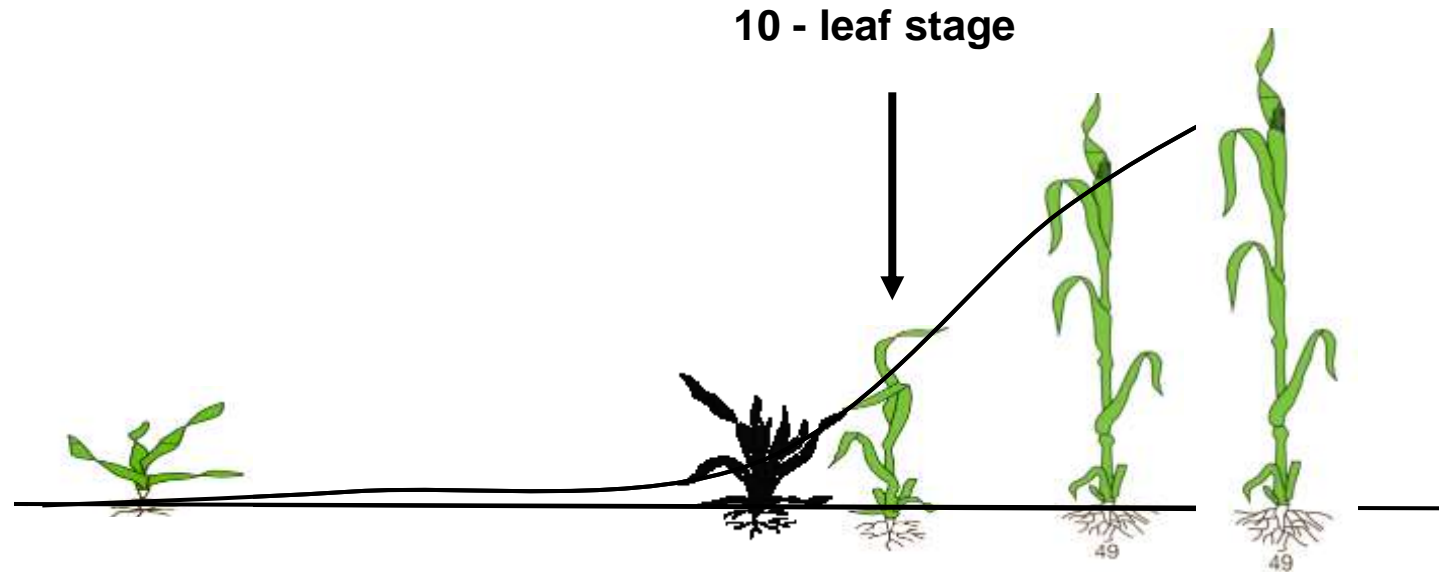
Notes: The figures in the parentheses are the T value of estimates.***, **, * denote significance at

1%, 5% and 10% respectively. For comparison, the coefficient of the variable "household size" is 0.001.

Questions

- **Can information/knowledge of N-fertilizer use be effectively delivered by local extension staff under current extension system?**
- **How farmers respond to information delivered by extension staff?**
- **What are impacts on N-fertilize use?**

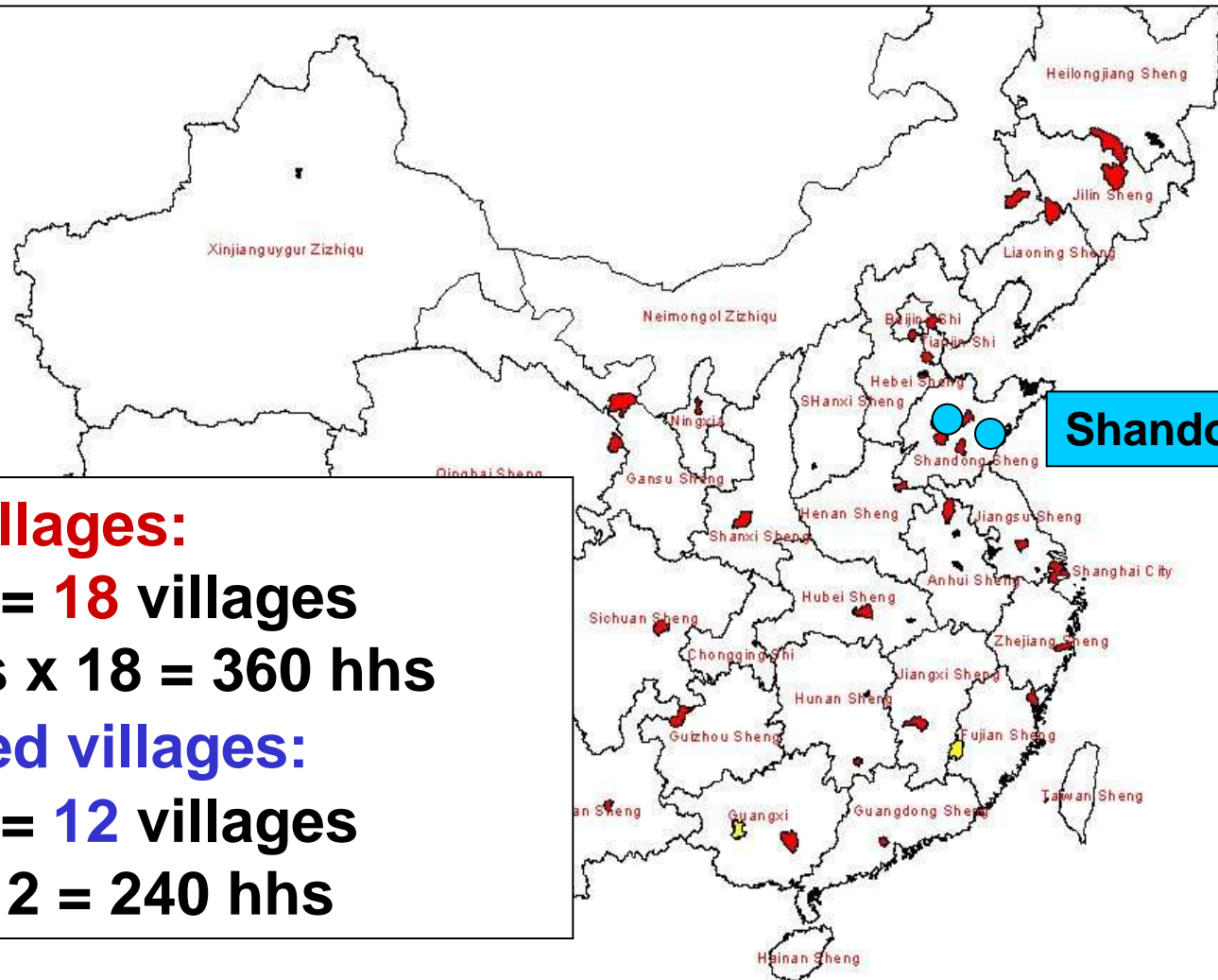
Technology: Improved N Management for Maize Production



- **Recommendation:**

- Reduce **overall** N use to 150-180 kg ha⁻¹
- **Before** 10-leaf stage: 50-60 kg ha⁻¹
- **After** 10-leaf stage: 100-120 kg ha⁻¹

Maize experiments in 3 townships in each of Huimin and Shouguang county, Shandong Province, 2010



Shandong

Treated villages:

$3 \times 3 \times 2 = 18$ villages

$20N^T \text{ hhs} \times 18 = 360 \text{ hhs}$

Controlled villages:

$2 \times 3 \times 2 = 12$ villages

$20 \text{ hh} \times 12 = 240 \text{ hhs}$

county
city
Prov

Results

- Can information/knowledge of N-fertilizer use be effectively delivered by local extension staff under current extension system? **No, very difficult!**
- How farmers respond to information delivered by extension staff? **They did not follow the guideline rather did it in their own SIMPLE way!**
- What were impacts on N-fertilize use? **Yes, there were, but less than we expected.**

Nitrogen uses by maize farmers: under training treatment

	Training	Control
By design (kg/ha)	150-180	
Actual (kg/ha)	201	259***
Frequency of N use	1.48	1.56

While extension staff were not interested in providing training to farmers, when it occurred, it mattered (though N reduction was still less than planned).

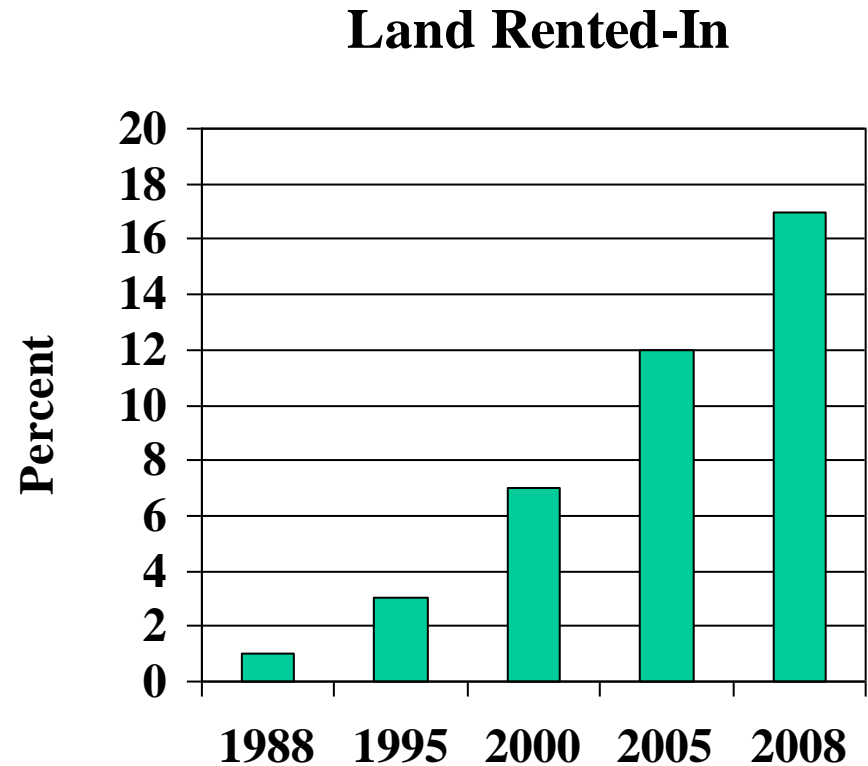
Interesting thing is: farmers did NOT followed the FULL guideline, but by overall reduction of N-fertilizer use.

Summary of results on maize

- **Get simple technologies ...**
 - **slow release fertilizer**
 - **nitrification inhibitors**
- **Without extension institutional reform, N-saving technology is difficult to be scaled up...;**
- **Training (or information) does matter (-22% of N-fertilizer use), but farmers did it in their own way...**
- **Reduction N-fertilizer uses did not lead to fall in yield.**
- **Cost saving: 15-20 yuan/mu – 1/4 of off-farm wage/day!
This may work for large farming, but it is challenging for small and part-time farms – average 0.6 ha**

Rising rental market

- **Rapidly increasing over time**
- **More than 40% in developed provinces (e.g., Zhejiang)**



Agriculture in Transition and Current Extension Efforts

Transition:

Extension effort

■ Output in transition

- Grain + +++)
- High-value crops +++)
- Rising animal sector +++)

■ Input in transition

- Labor +++) +/0
- Land ++ 0
- Capital ++ 0

Agriculture in Transition and Current Extension Efforts

Transition:

Extension effort

■ Output in transition

- Grain + + + +
- High-value crops + + +
- Rising animal sector + + +

■ Input in transition

- Labor + + + + / 0
- Land + + 0
- Capital + + 0

■ Market in transition

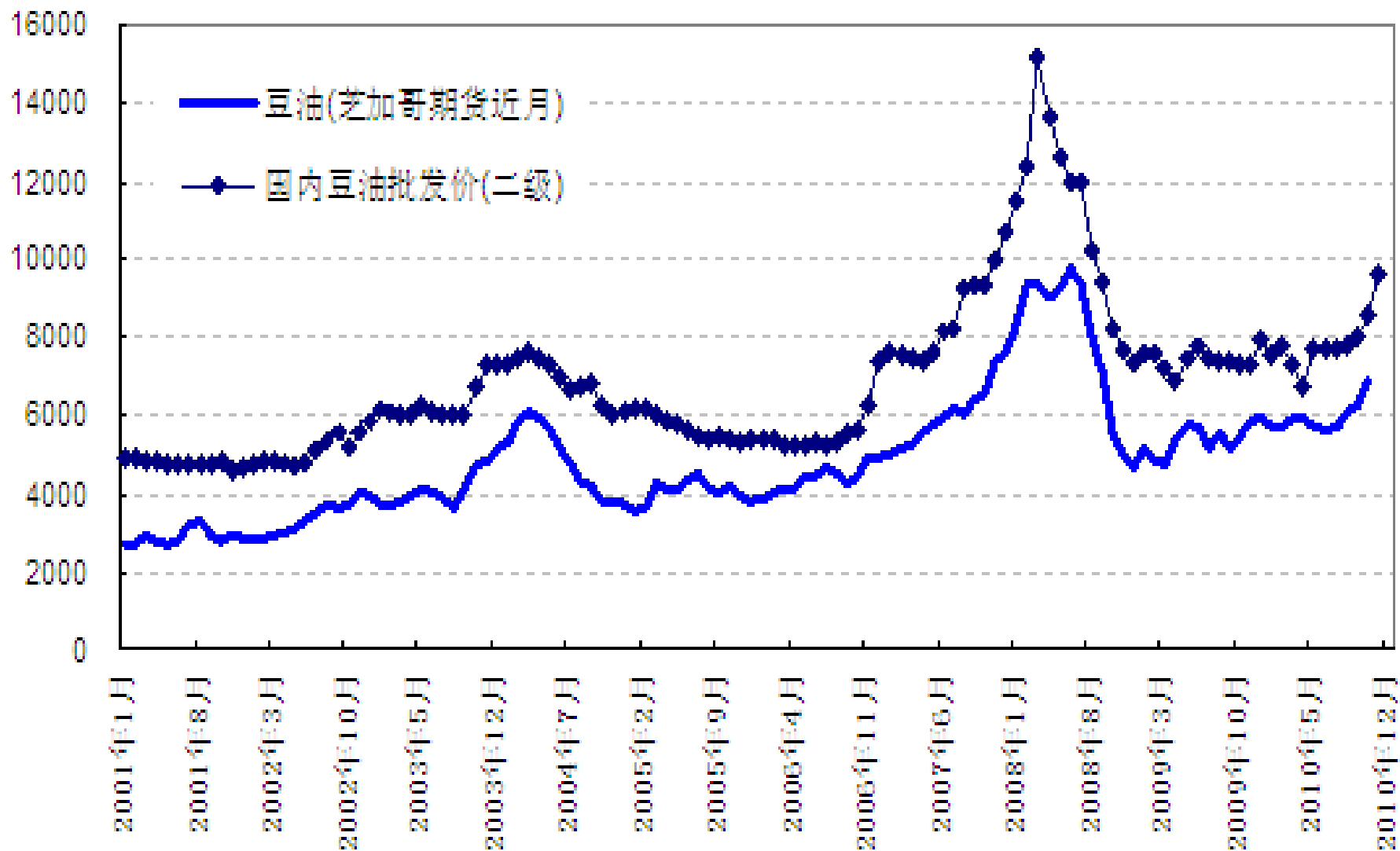
- Safety products + + + +
- Modern mkt chain + +
- Price instability + + + +

Table 7. Safety and quality inspection by channels in Greater Beijing in 2004 and 2009.

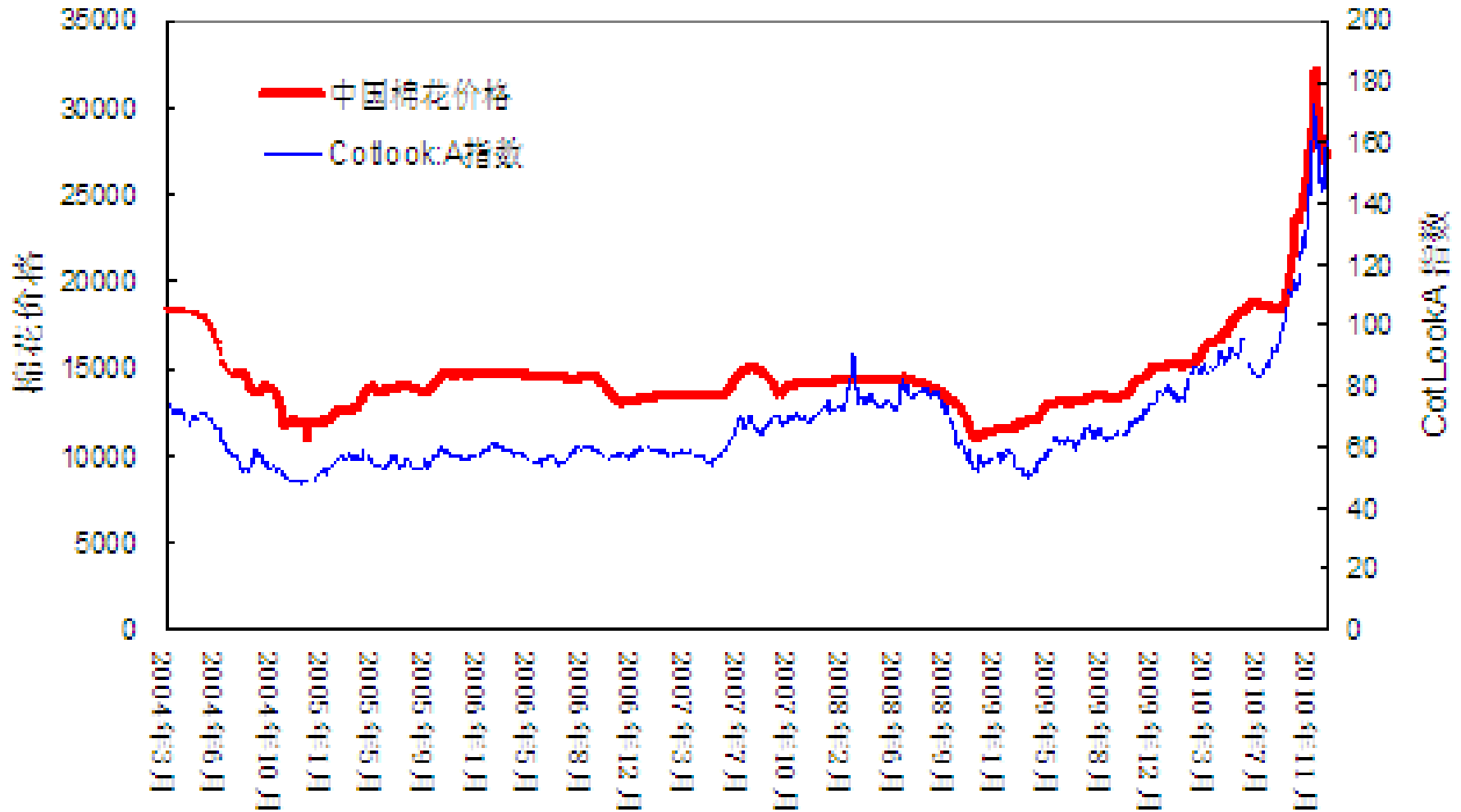
Primary buyers	Sample	Share of Households Inspected (%)			
		Safety: Anti-Biotic	Safety: Somatoplasm	Quality: fat rate	Quality: lacto-protein
2004					
Mobile brokers	24	54	0	0	0
Milk stations	99	56	0	0	0
2009					
Mobile brokers	1	0	0	0	0
Milk stations	13	77	8	69	77
Dairy complexes	38	95	24	79	79

Source: Huang et. al (2012)

International and domestic soybean oil price (yuan/ton)



International and domestic cotton price (yuan/ton)



Agriculture in Transition and Current Extension Efforts

Transition:

Extension effort

■ Output in transition

- Grain + + + +
- High-value crops + + +
- Rising animal sector + + +

■ Input in transition

- Labor + + + + / 0
- Land + + 0
- Capital + + 0

■ Market in transition

- Safety products + + + + +
- Modern mkt chain + + 0
- Price instability + + + + 0

Outline of Presentation

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- **Challenges of Agricultural Extension**
- **Concluding Remarks**

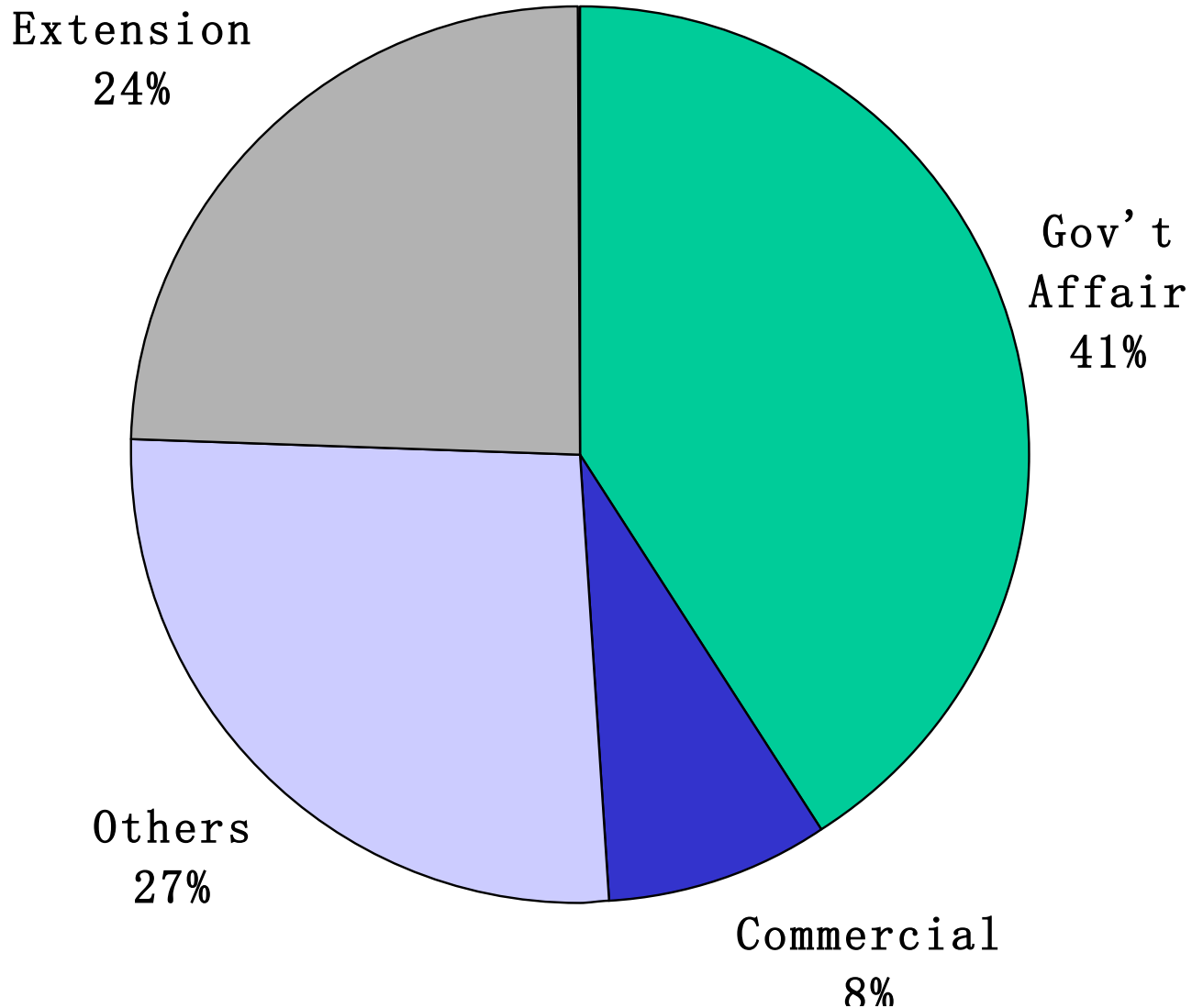
CCAP's Agricultural Extension Survey in 2005/2006

35 counties from 7 Provinces:

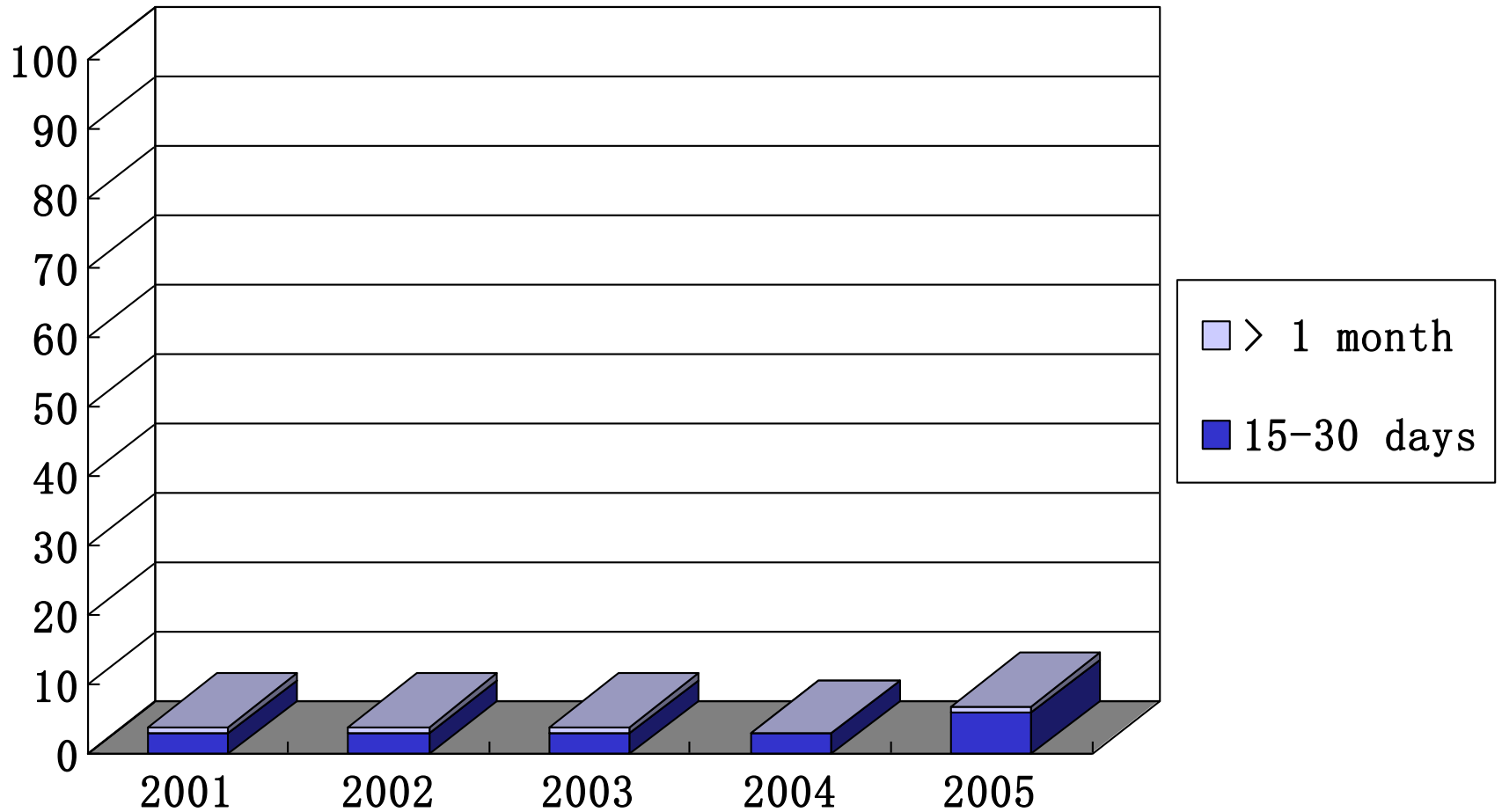
203 extension stations

557 extension staff

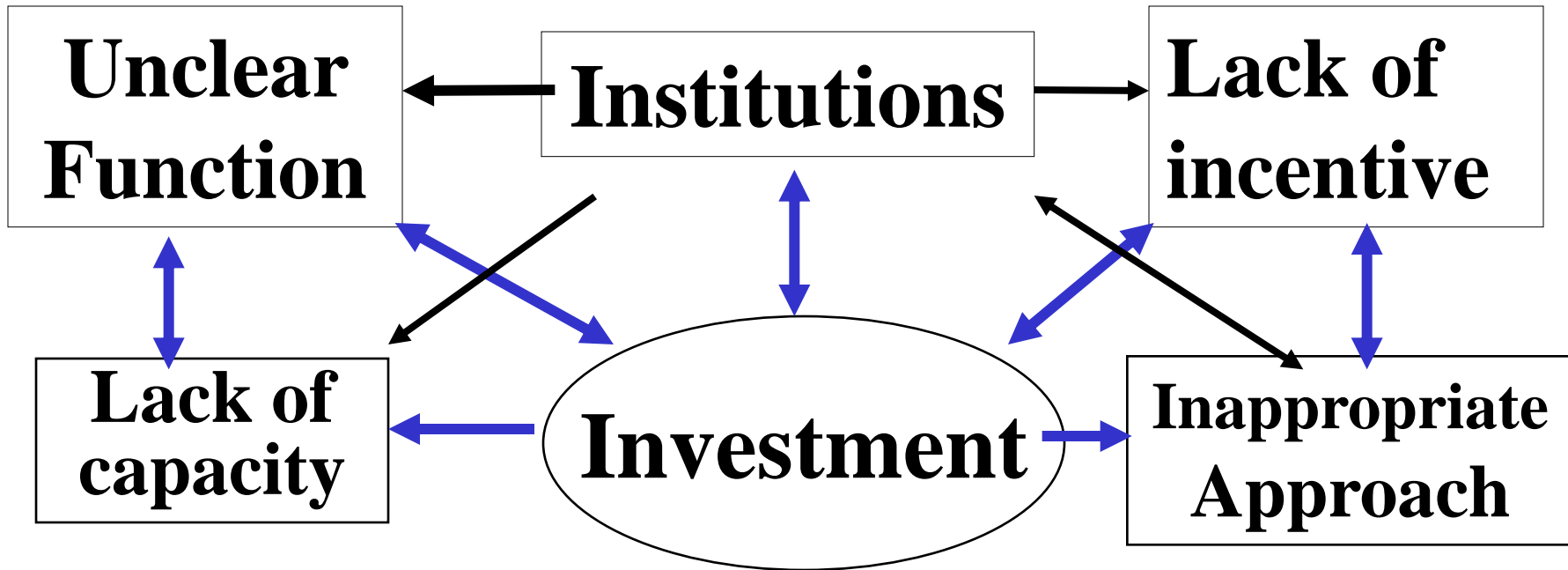
Time allocation of extension staff in 2005



Percentage of extension staff attended training in 2001-2005



Challenges of public extension system



Concluding Remarks

Transition:

Public extension

■ Output in transition

- Grain + +++
- High-value crops +++ + → ++
- Rising animal sector +++ + → ++

■ Input in transition

- Labor +++ +/0 → +++
- Land ++ 0 → ++
- Capital ++ 0 → ++

■ Market in transition

- Safety products +++ +/0 → +++
- Modern mkt chain ++ 0 → ++
- Price instability +++ 0 → ++

Concluding Remarks

Transition:	Public	Private
■ Output in transition		
- Grain +	+++	+++
- High-value crops +++	+ → ++	+++
- Rising animal sector +++	+ → ++	+++
■ Input in transition		
- Labor +++	+ / 0 → +++	++
- Land ++	0 → ++	
- Capital ++	0 → ++	++
■ Market in transition		
- Safety products +++	+ / 0 → +++	++
- Modern mkt chain ++	0 → ++	+++
- Price instability +++	0 → ++	

Concluding Remarks

- **Reform public agricultural extension system**
- **Invest in agricultural extension system**
- **Establish public-private partnership**
- ...