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Fertilizer situation in China

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China National Chemical Information Center

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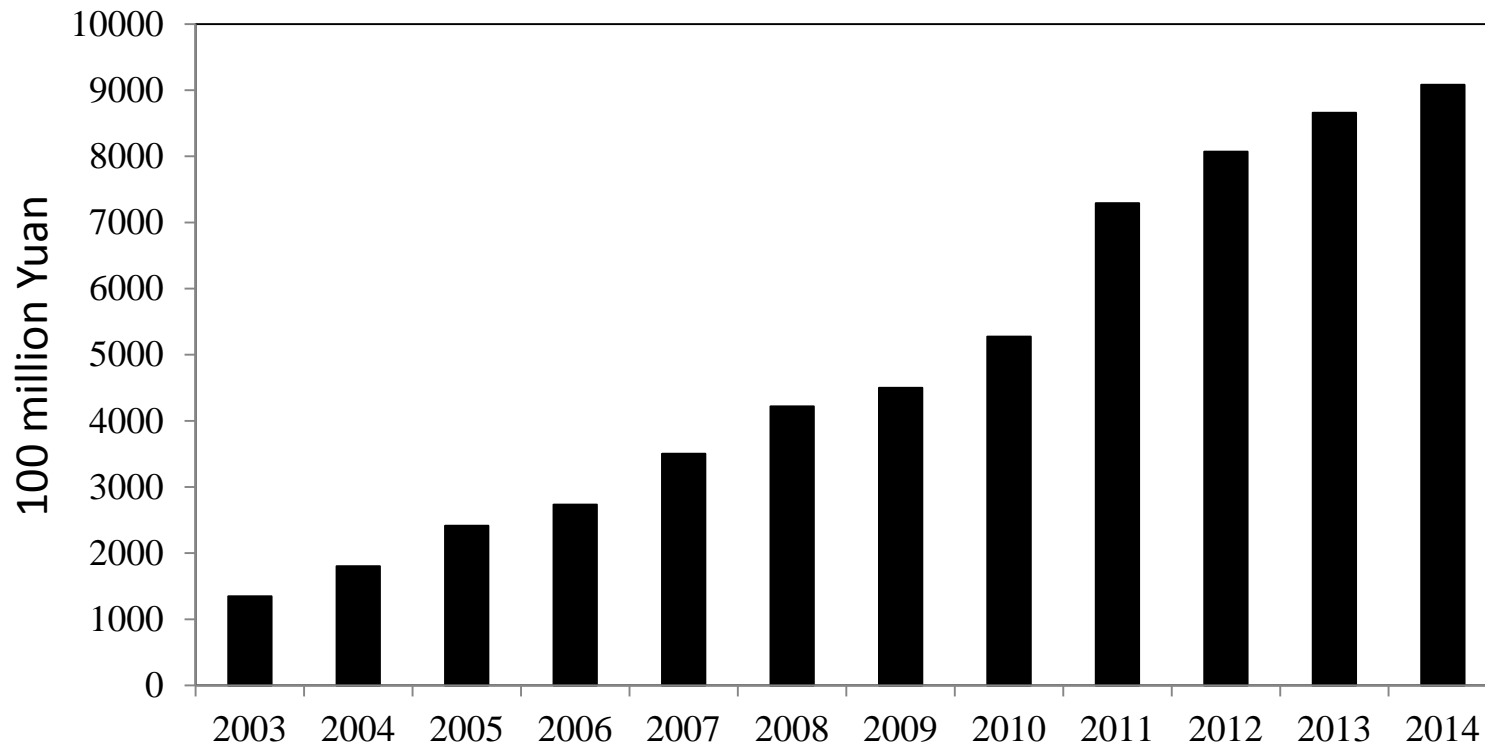
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Outline

- Fertilizer production in China
- Fertilizer market price trend
- Fertilizer use in China
- Improvement in technology and policy
- Challenge and perspective

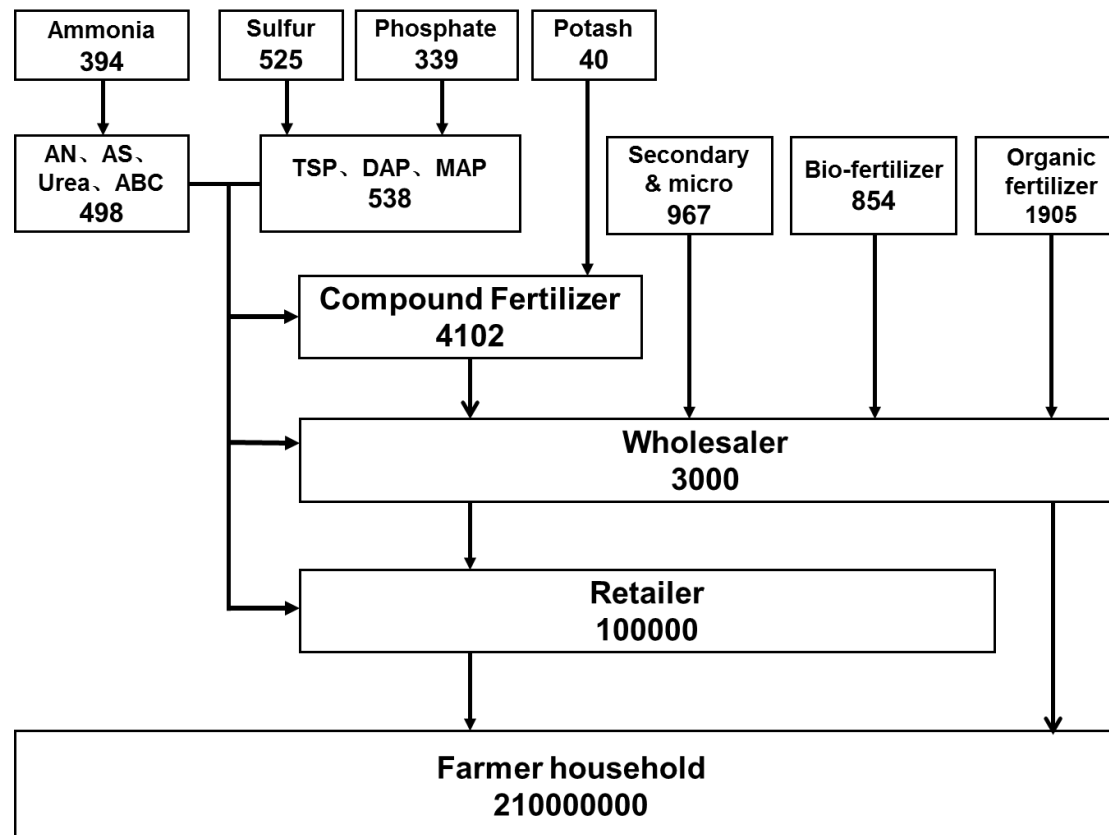
Fertilizer production in China

During the past 12 year, Chinese fertilizer industry experienced the rapid development. The gross output value of fertilizer increased six fold from 2003 to 2014.



Fertilizer production in China

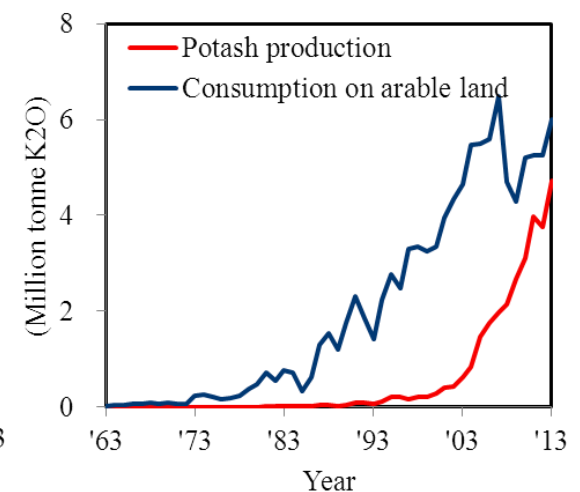
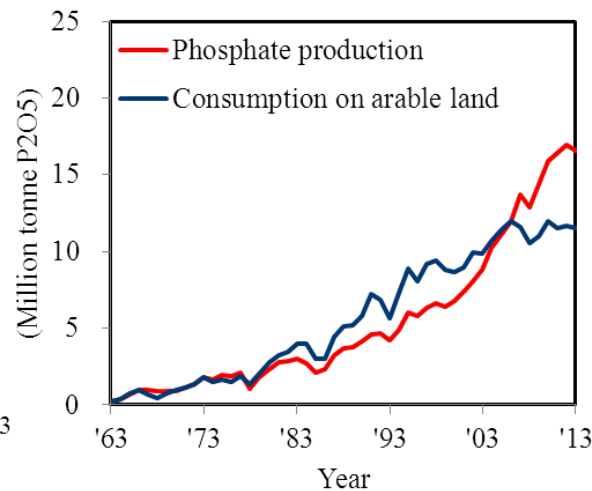
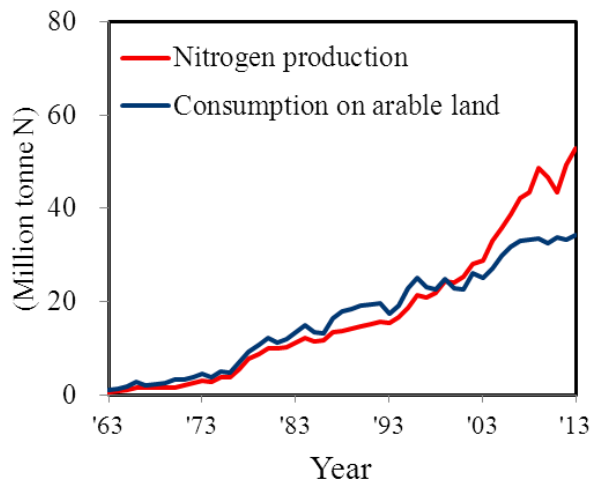
Large number of fertilizer producers and distributors



Fertilizer production in China

High production increase VS Low consumption increase

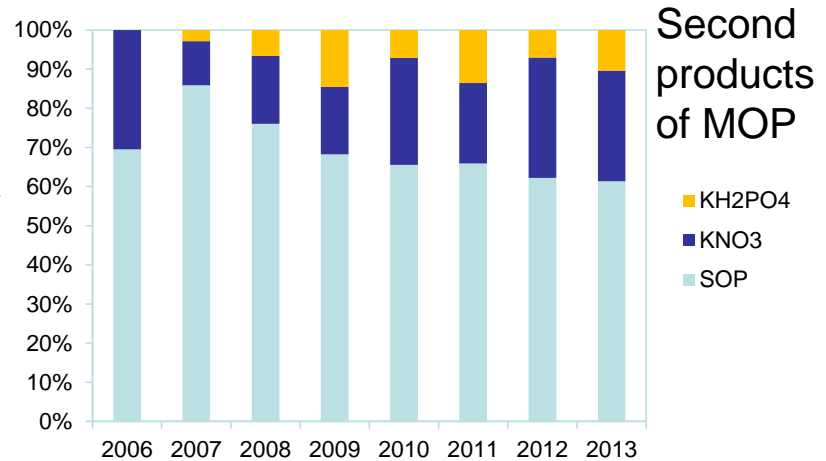
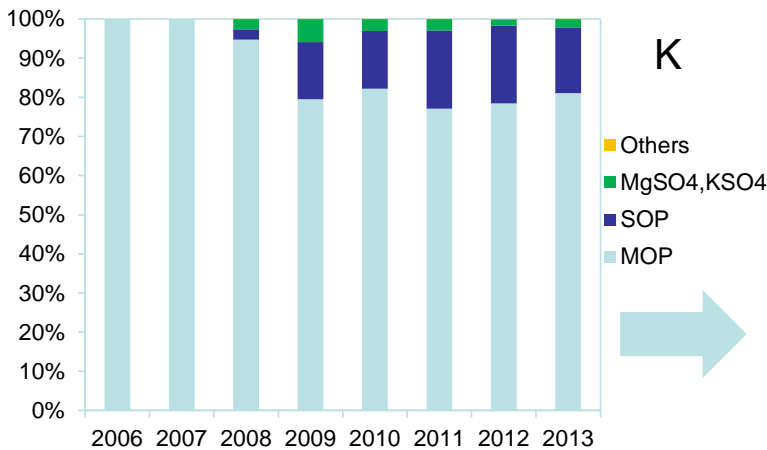
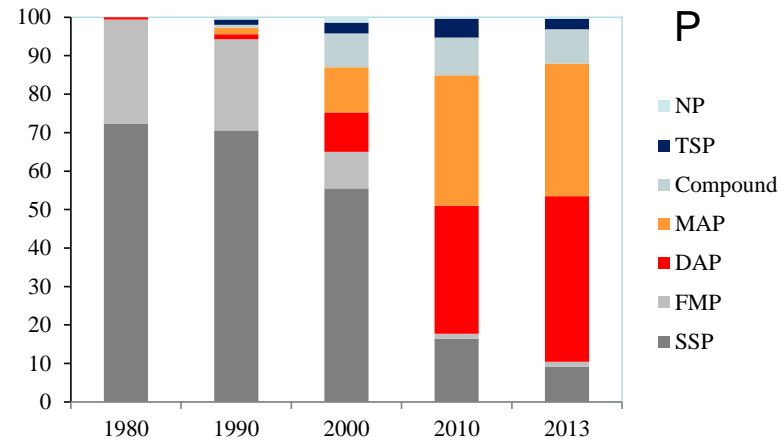
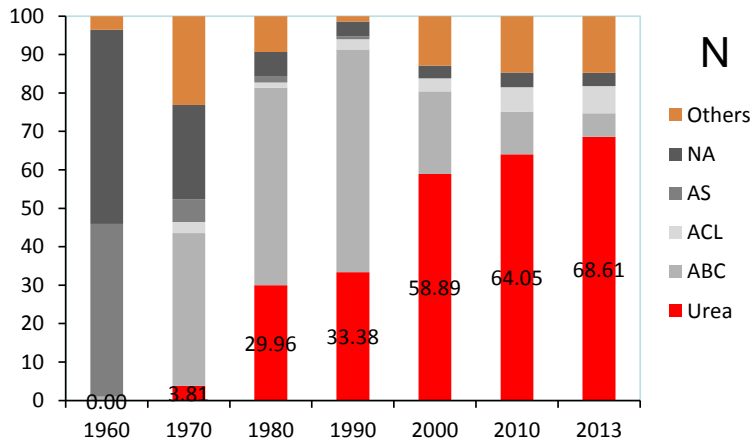
In last ten years, the growth rate of fertilizer production was much higher than before.



The domestic agricultural consumption showed a relative slow increase.

Fertilizer production in China

Fertilizer products varied obviously



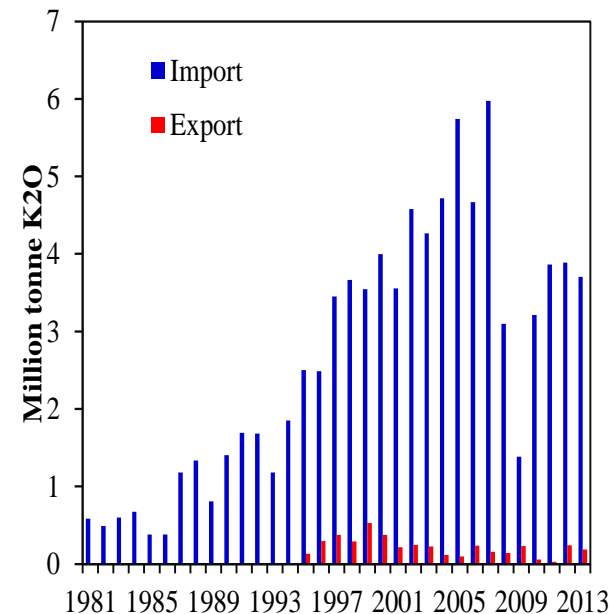
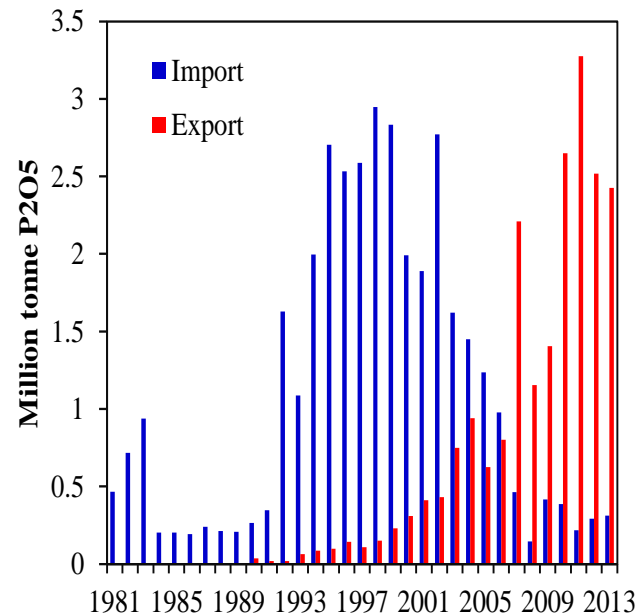
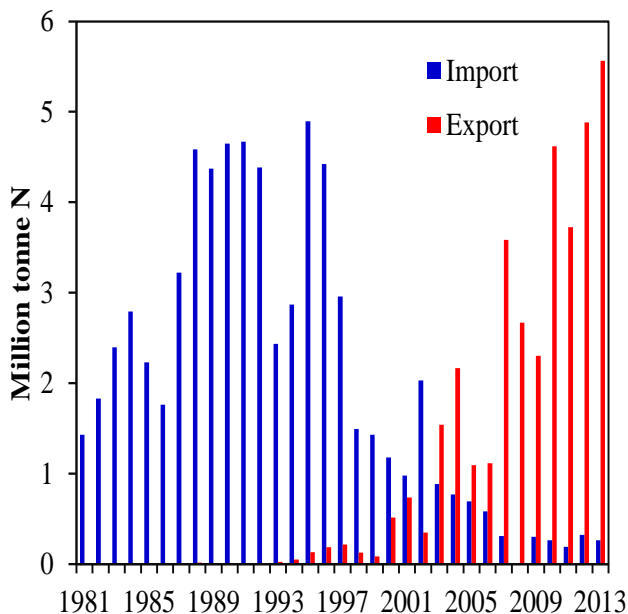
Fertilizer production in China

Fertilizer registration increased significantly

Changes of fertilizer products registered between 2008-2013			
	Products in 2008	Products in 2013	Changes (%)
Total	35,132	64,340	83
Compound	24,222	32,942	36
Blended	4,511	20,346	351
Organic	3,137	5,890	88
Mix of organic and inorganic	1632	3,225	98
Micro soluble	1242	1357	9
Slow release	676	1133	68
Bio fertilizer	349	376	8
Soil amendment	278	352	27
Secondary soluble	51	78	53
Macro soluble	11	48	336
Micro	42	16	-62
Secondary	4	13	225
MgSO₄	7	8	14
Ca(NO₃)₂	6	2	-67

Fertilizer production in China

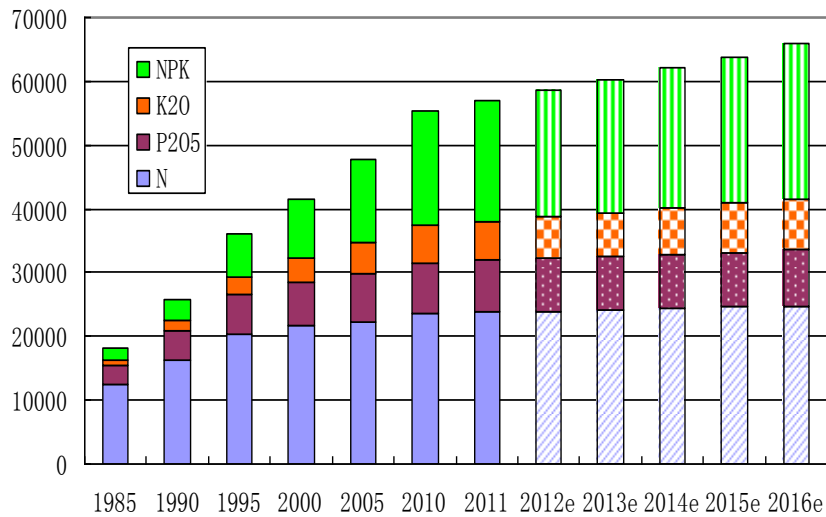
Big changes in fertilizer trade



Nitrogen Fertilizer and Phosphate Fertilizer export stayed at high level;
Potash Fertilizer import kept stable during the 5 years.

Fertilizer production in China

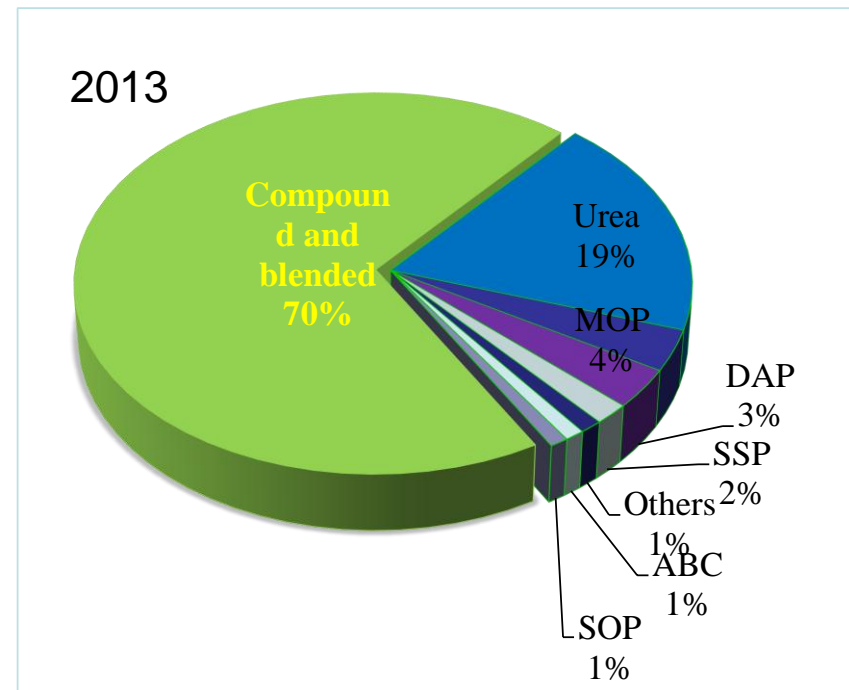
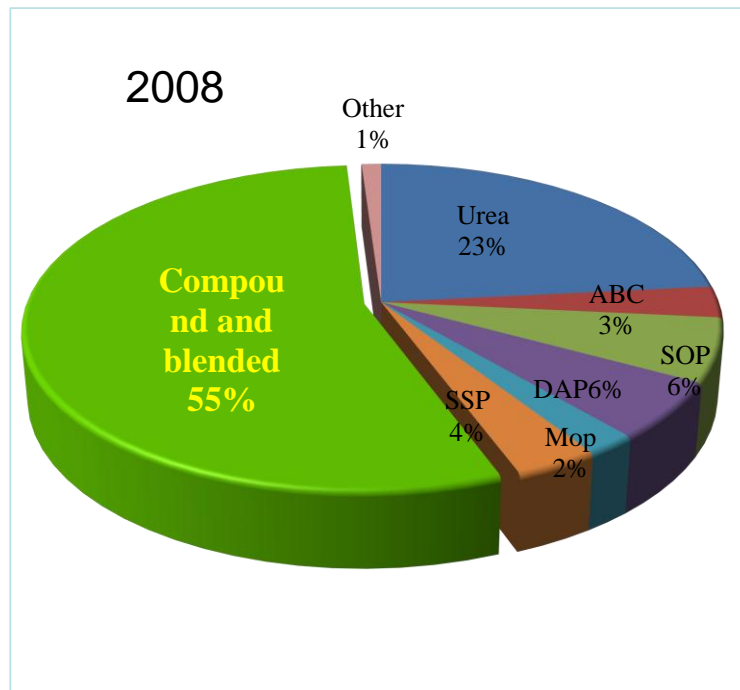
The growth rate of China's fertilizer demand tended to level off.



	Fert.	N	P ₂ O ₅	K ₂ O	NPK
1991-2000	4.85	2.85	4.16	9.87	10.49
2001-2010	2.97	0.83	1.60	4.59	7.06
2011-2017e	3.09	0.80	1.30	6.00	5.00

Fertilizer production in China

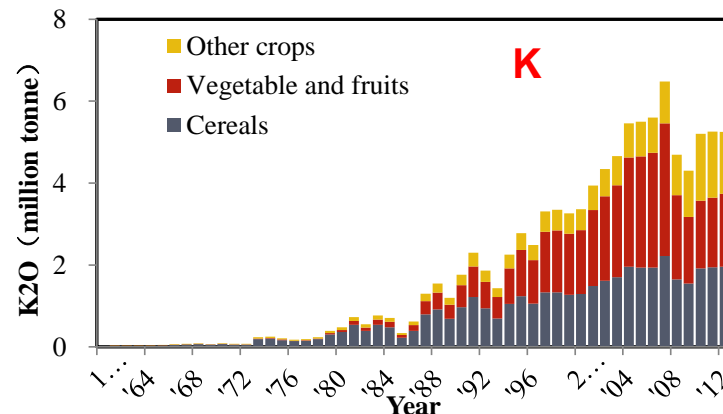
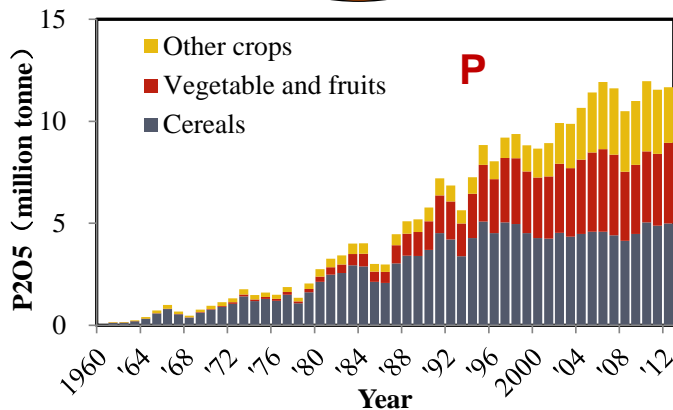
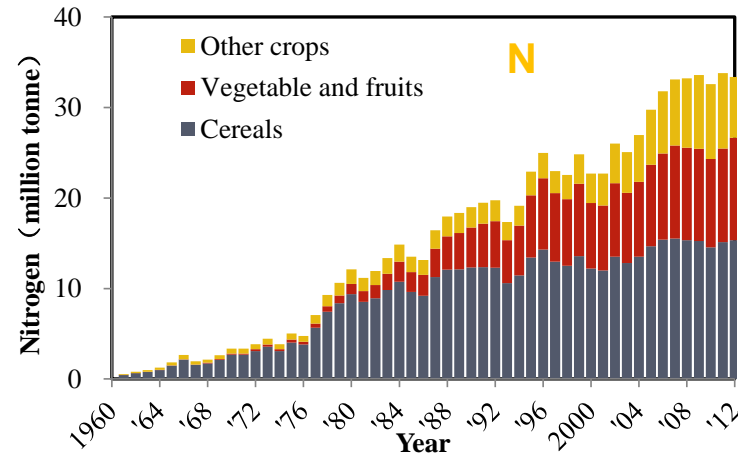
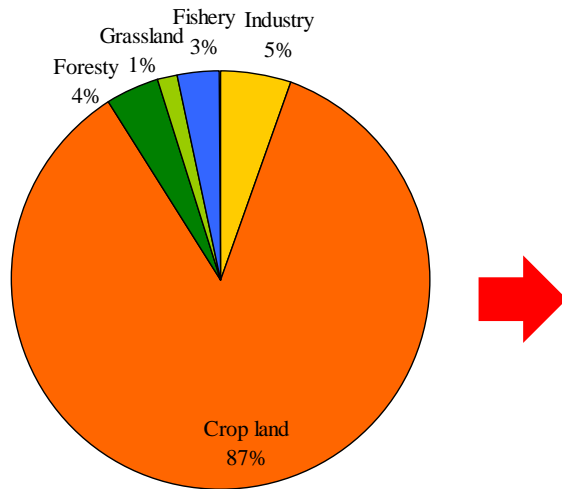
NPK Fertilizer dominated the terminal usage market.



Fertilizer cost for grain crops

Fertilizer production in China

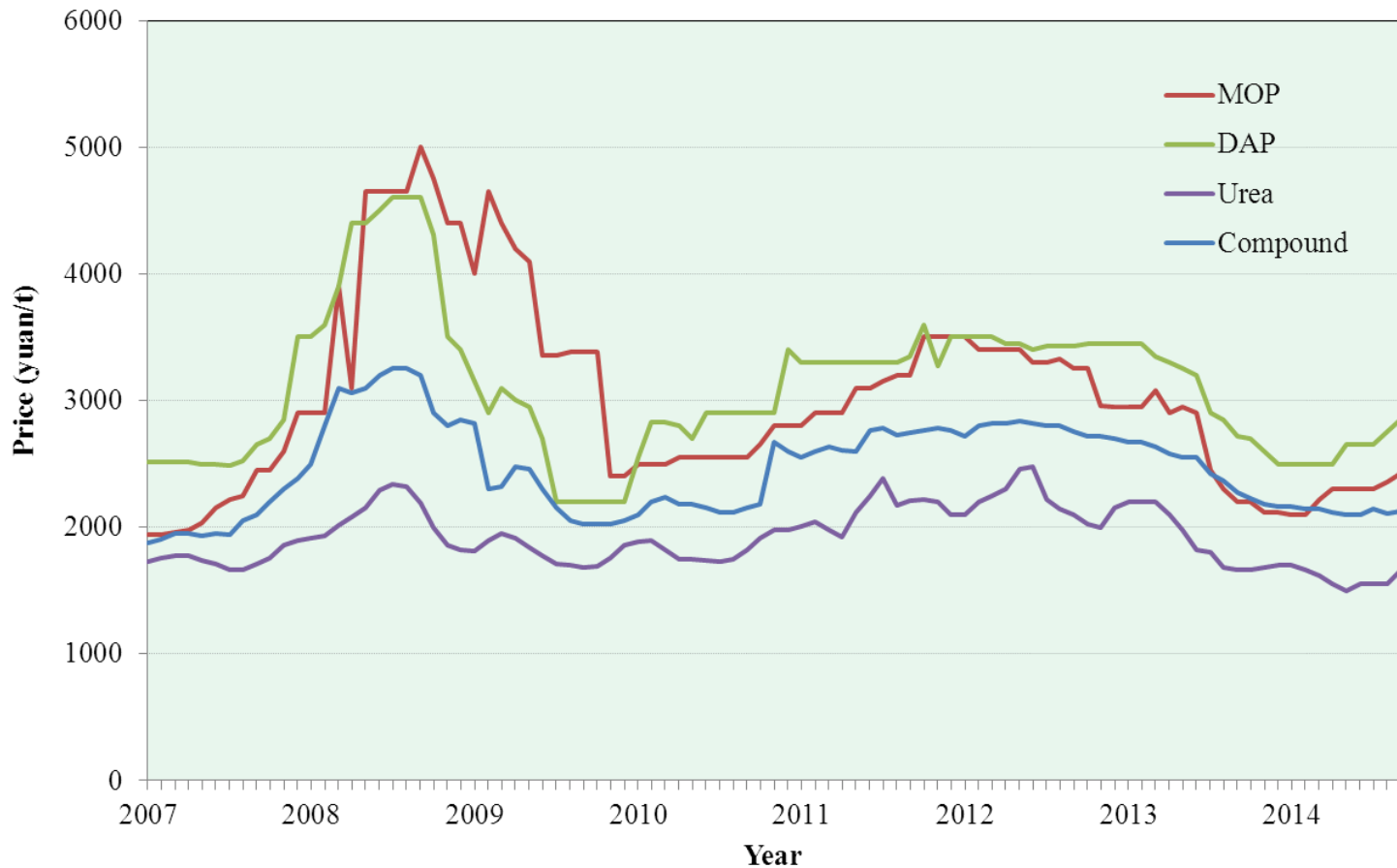
Fertilizer allocation also changed greatly.



Weifeng Zhang, unpublished

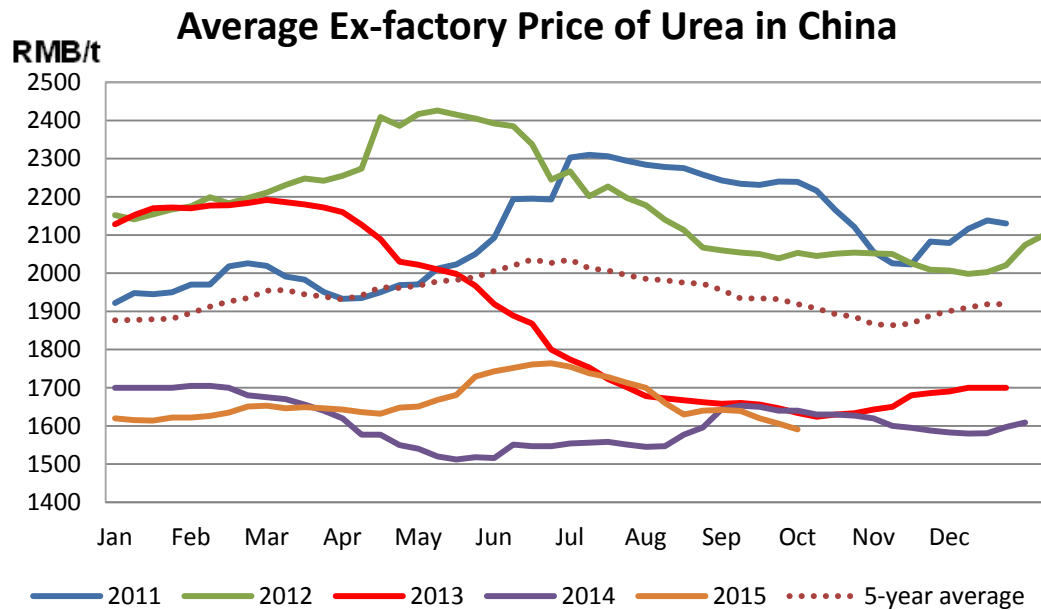
Fertilizer market price trend

Fertilizer prices were affected by the changes of energy, policies and international markets.



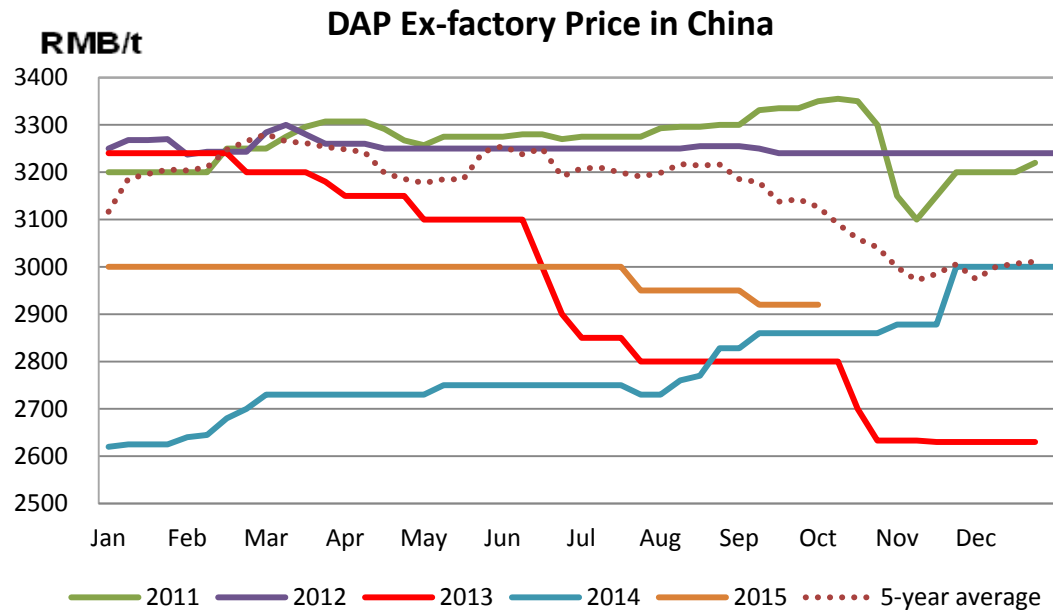
Fertilizer market price trend

The urea price in China stayed at low level.



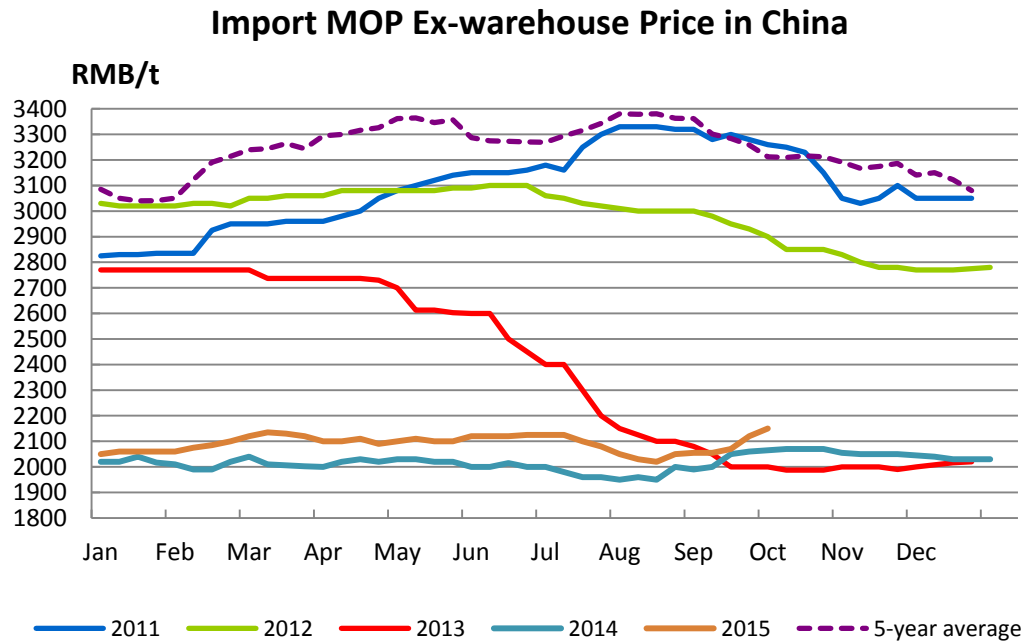
Fertilizer market price trend

The DAP price in China kept steady.



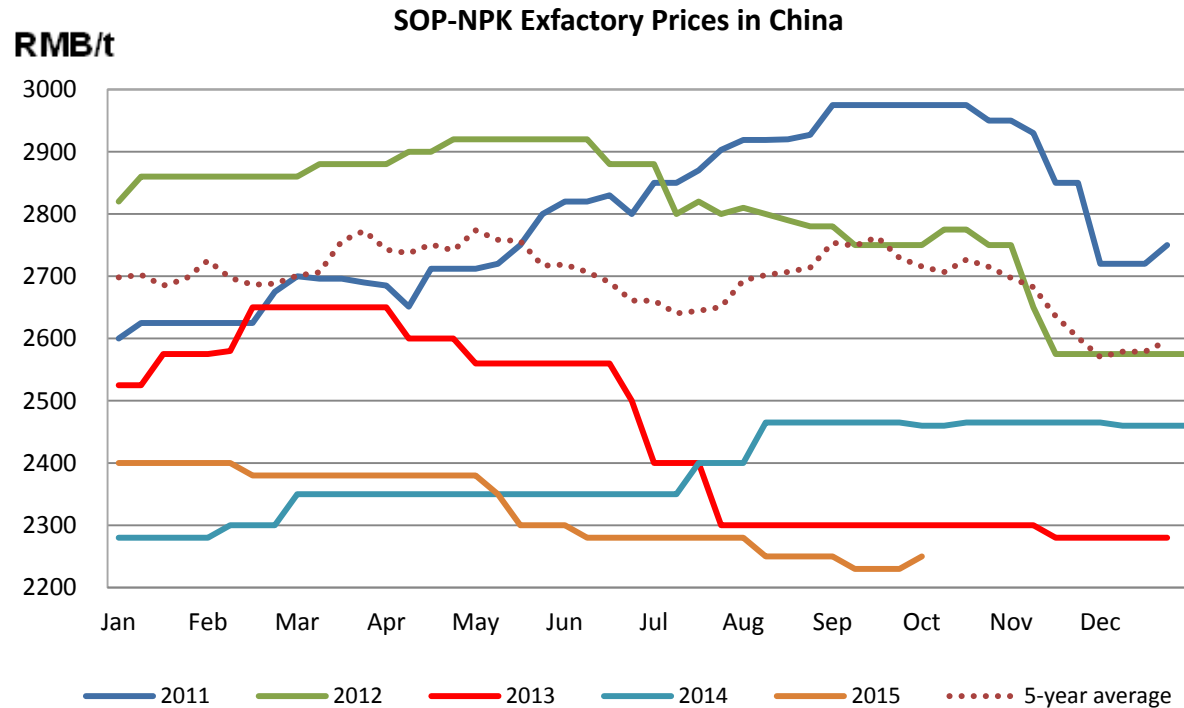
Fertilizer market price trend

The import MOP price bottomed down.



Fertilizer market price trend

The NPK in China hovered at low price.



Fertilizer use in China

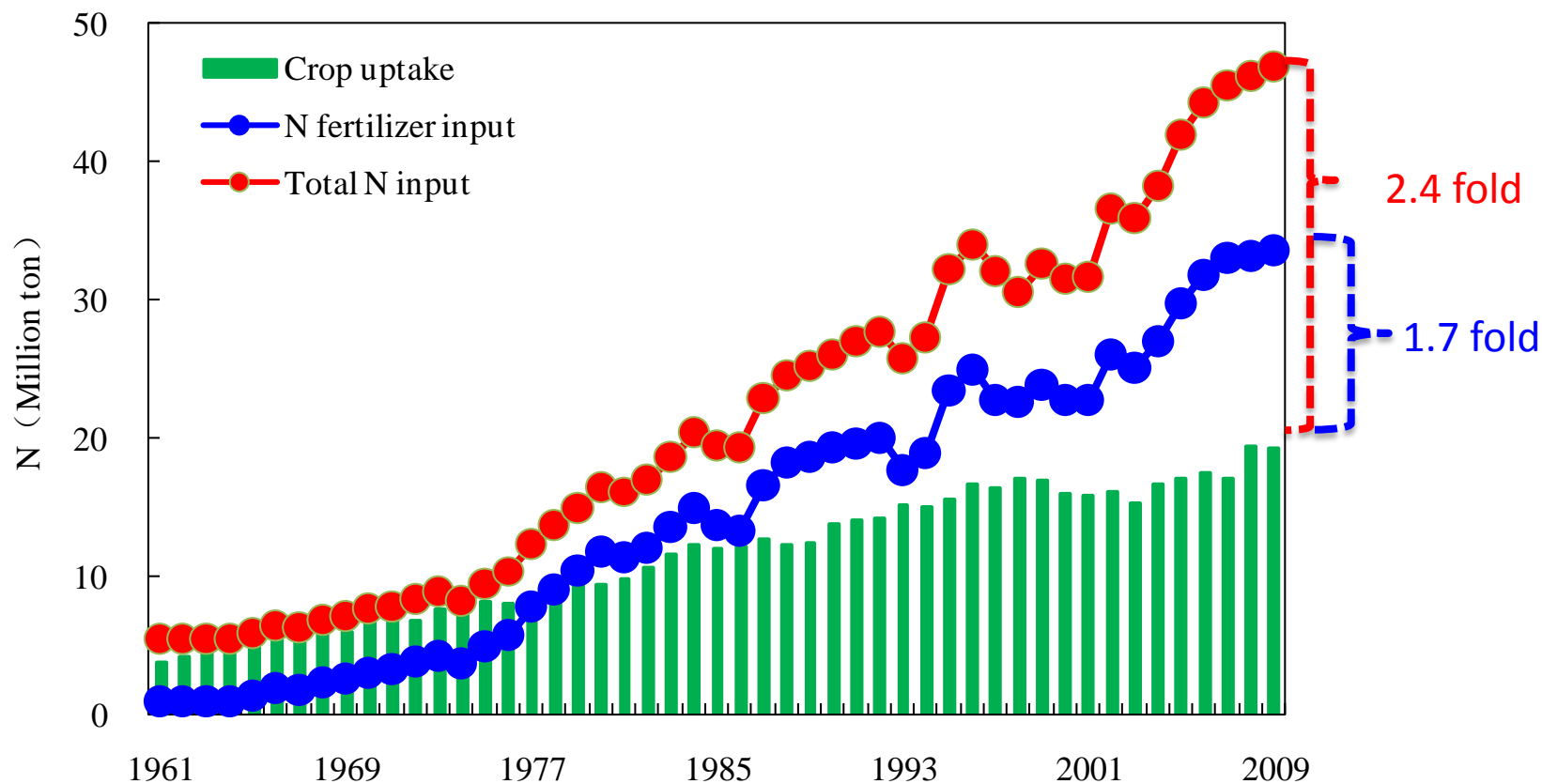
Chemical fertilizer application rate is relatively higher in China.



Fertilizer use in China

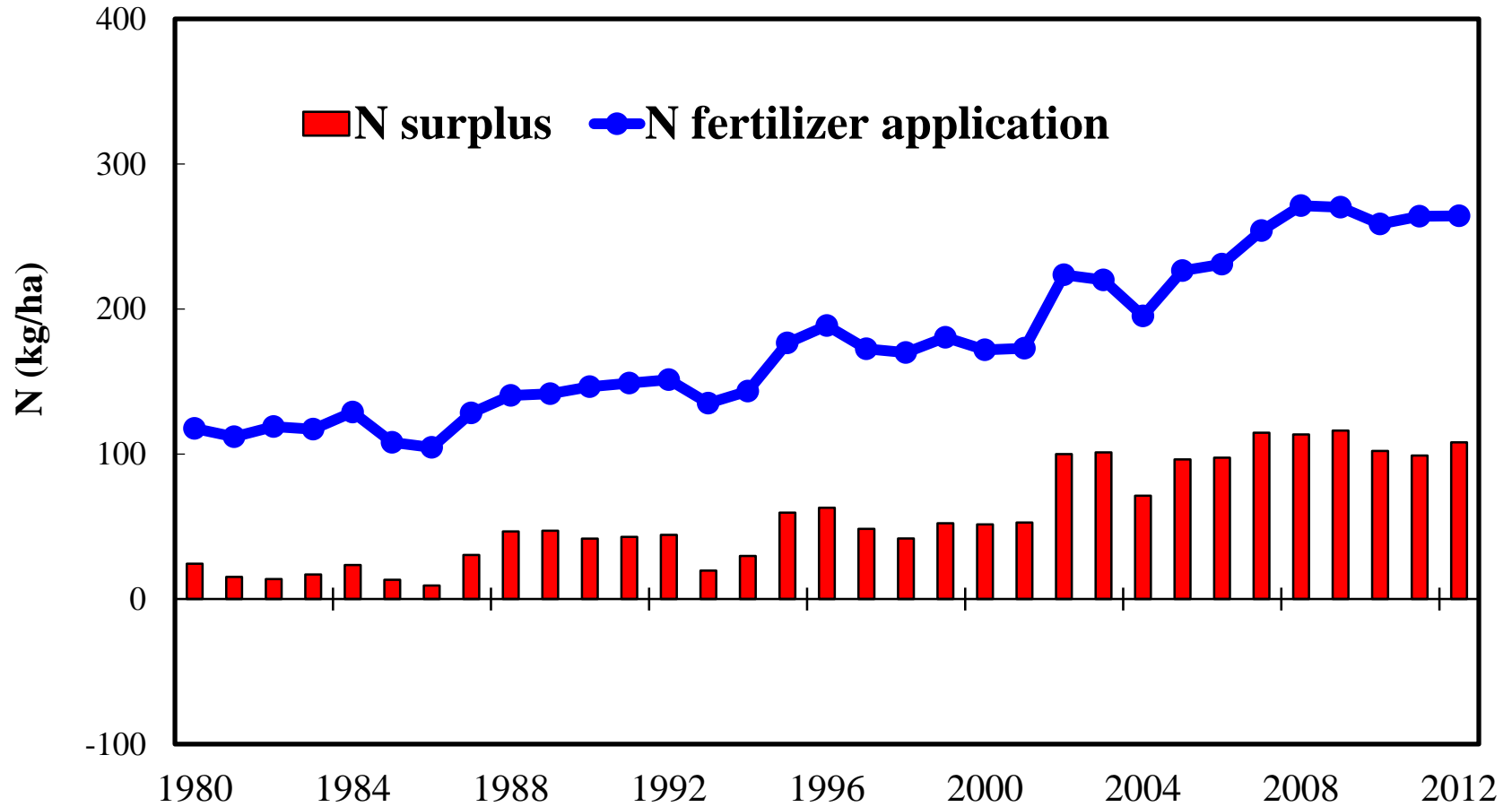
N fertilizer input is 1.7 fold higher than crop uptake

Total N input is 2.4 fold higher than crop uptake

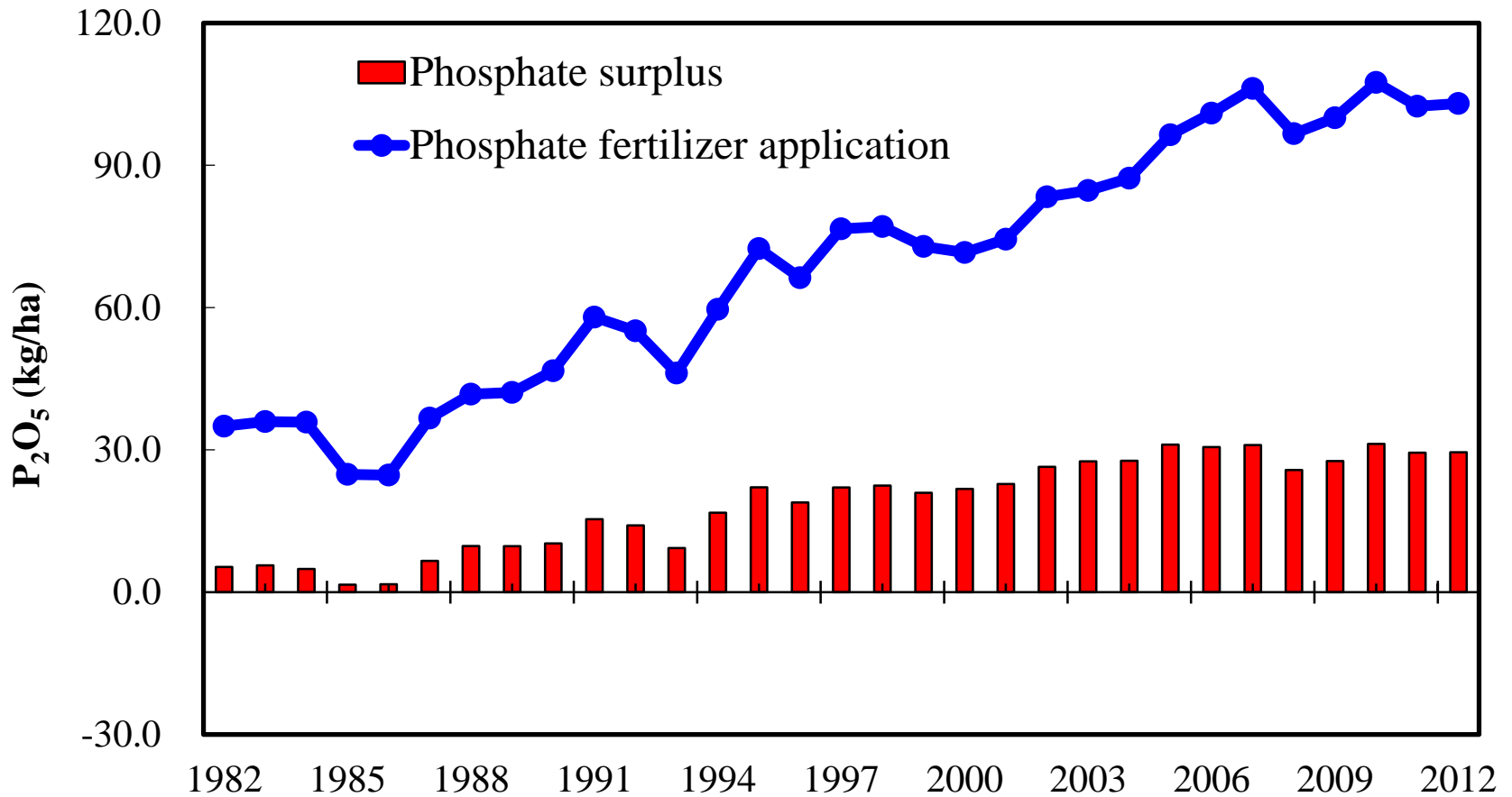


N input and crop uptake in Chinese crop land in 1961-2009

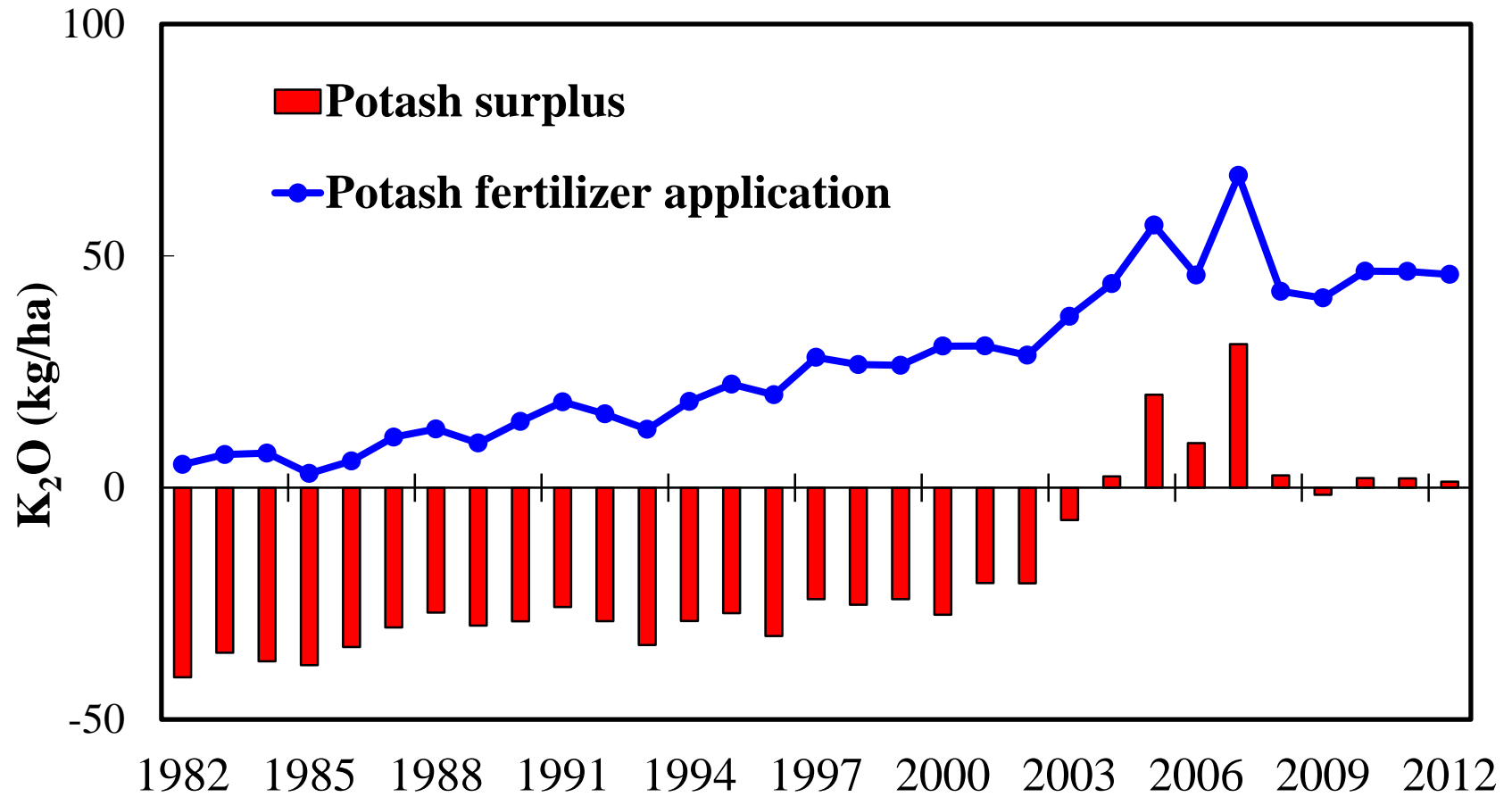
Fertilizer use in China



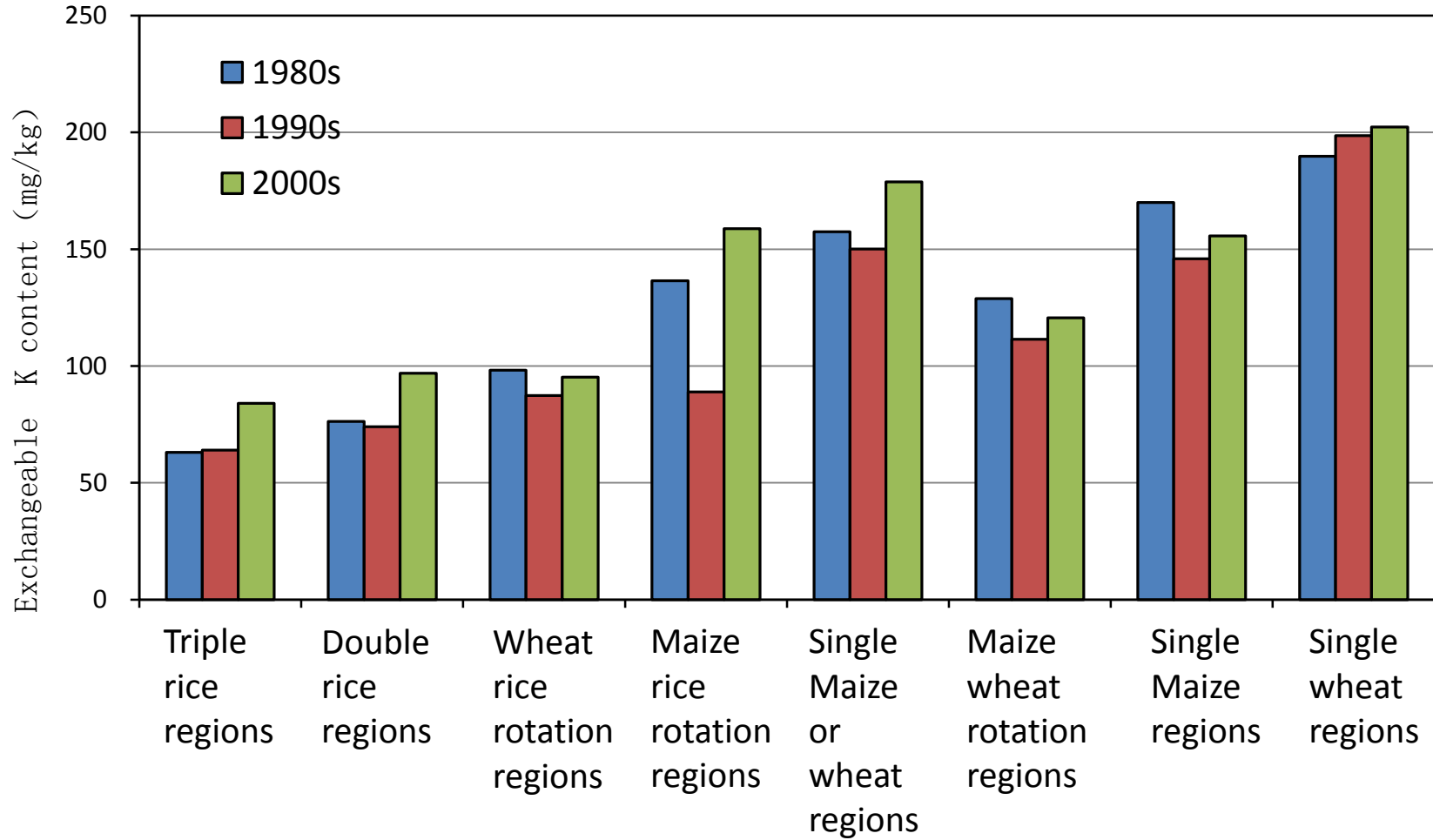
Fertilizer use in China



Fertilizer use in China



Fertilizer use in China



Fertilizer use in China

Current production capacity is enough to support future demand in terms of high recourse use efficiency, food and environment safety.

Baseline and forecast for fertilizer development in China

(Million Tonne)	Situation in 2013				Forecast for 2030	
Fertilizer	Production capacity	Real production in 2013	Total consumption in agriculture and industry	Consumption in agriculture	Demand for agriculture to keep balance	Theory demand for agriculture, industry and export
Nitrogen	59.49	52.87	45.41	34.20	21	30
phosphate	23.50	16.53	12.61	11.48	6.79	10
Potash	5.91	4.72	7.38	6.0	4.74	6

Fertilizer use in China

Eutrophication



Fertilizer use in China

LETTER

NATURE (*Liu et al., 2013*)

doi:10.1038/nature11917

Enhanced nitrogen deposition over China

Xuejun Liu^{1*}, Ying Zhang^{1*}, Wenxuan Han¹, Aohan Tang¹, Jianlin Shen¹, Zhenling Cui¹, Peter Vitousek², Jan Willem Erisman^{3,4}, Keith Goulding⁵, Peter Christie^{1,6}, Andreas Fangmeier⁷ & Fusuo Zhang¹

1980: 13.2 kg N/ha

2000: 21.1 kg N/ha

+60%



Smog in Beijing

Fertilizer use in China

Nature China20100304 - ACDSee v3.1

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Significant Acidification in Major Chinese Croplands

J. H. Guo, *et al.*
Science **327**, 1008 (2010);
 DOI: 10.1126/science.1182570

Home > Subject archive > Research Highlights

REPORTS

Significant Acidification in Major Chinese Croplands

J. H. Guo,^{1*} X. J. Liu,^{1*} Y. Zhang,¹ J. L. Shen,¹ W. X. Han,¹ W. F. Zhang,¹ P. Christie,^{1,2} K. W. T. Goulding,³ P. M. Vitousek,⁴ F. S. Zhang^{1†}

Soil acidification is a major problem in soils of intensive Chinese agricultural systems. We used two nationwide surveys, paired comparisons in numerous individual sites, and several long-term monitoring-field data sets to evaluate changes in soil acidity. Soil pH declined significantly ($P < 0.001$) from the 1980s to the 2000s in the major Chinese crop-production areas. Processes related to nitrogen cycling released 20 to 221 kilomoles of hydrogen ion (H^+) per hectare per year, and base cations uptake contributed a further 15 to 20 kilomoles of H^+ per hectare per year to soil acidification in four widespread cropping systems. In comparison, acid deposition (0.4 to 2.0 kilomoles of H^+ per hectare per year) made a small contribution to the acidification of agricultural soils across China.

[natureasia.com](#)

Highlights

Category: **Earth & environment**

13 March 2010 | doi:10.1038/nchina.2010.26

Chinese croplands turning sour

Acidification over the last twenty years has lowered the average Chinese

Soil acidification in major Chinese croplands. *Science* 327, 1008 (2010). doi:10.1126/science.1182570

China has intensified markedly since the 1970s. In 2007, the country produced 502 million tons of fertilizers, 54% more than in 1981, and 191% higher than the figures for 1981. Fusuo Zhang at China Agricultural University in Beijing and co-workers¹ have now shown by comparing data from past and present national soil surveys that the excess use of chemical

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Fertilizer use in China



Nematode

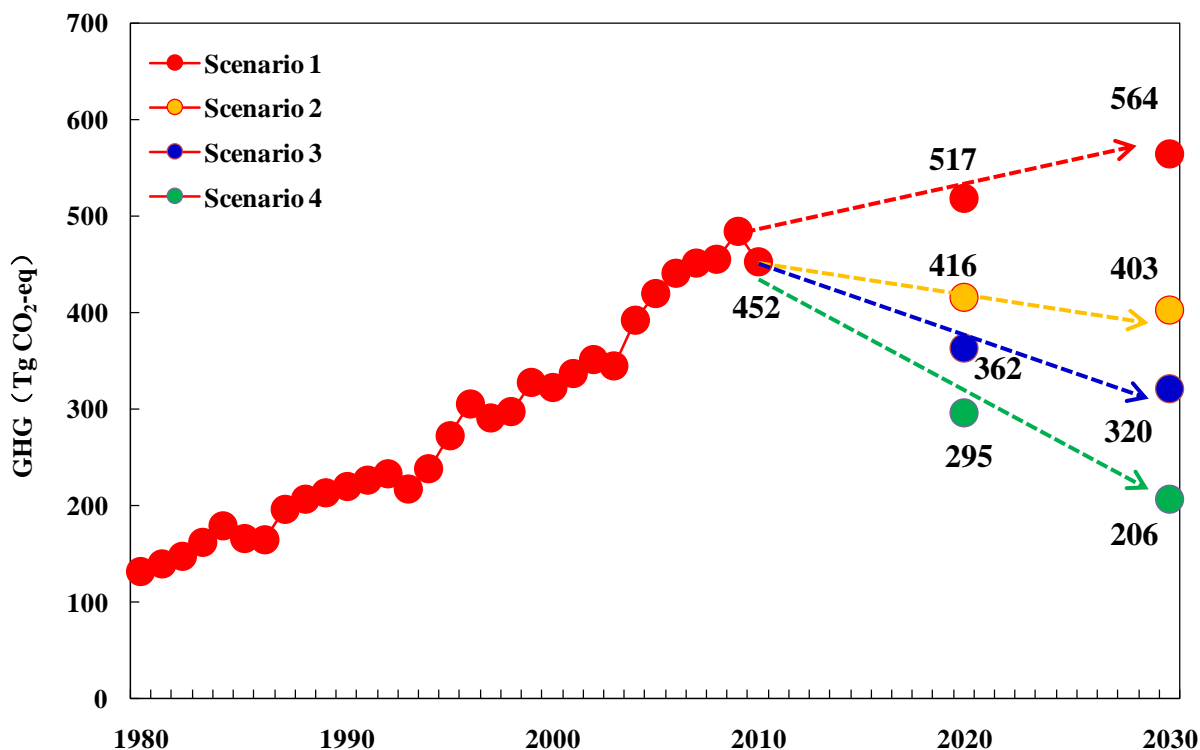


Fertilizer use in China



Fertilizer use in China

Controlling fertilizer use will reduce national GHG emission by 2-6%



Industry management

- CH₄ recovery in coal mining
- Improve Energy efficiency in fertilizer plants
- N₂O abatement in Nitric acid production
- Control N fertilizer export

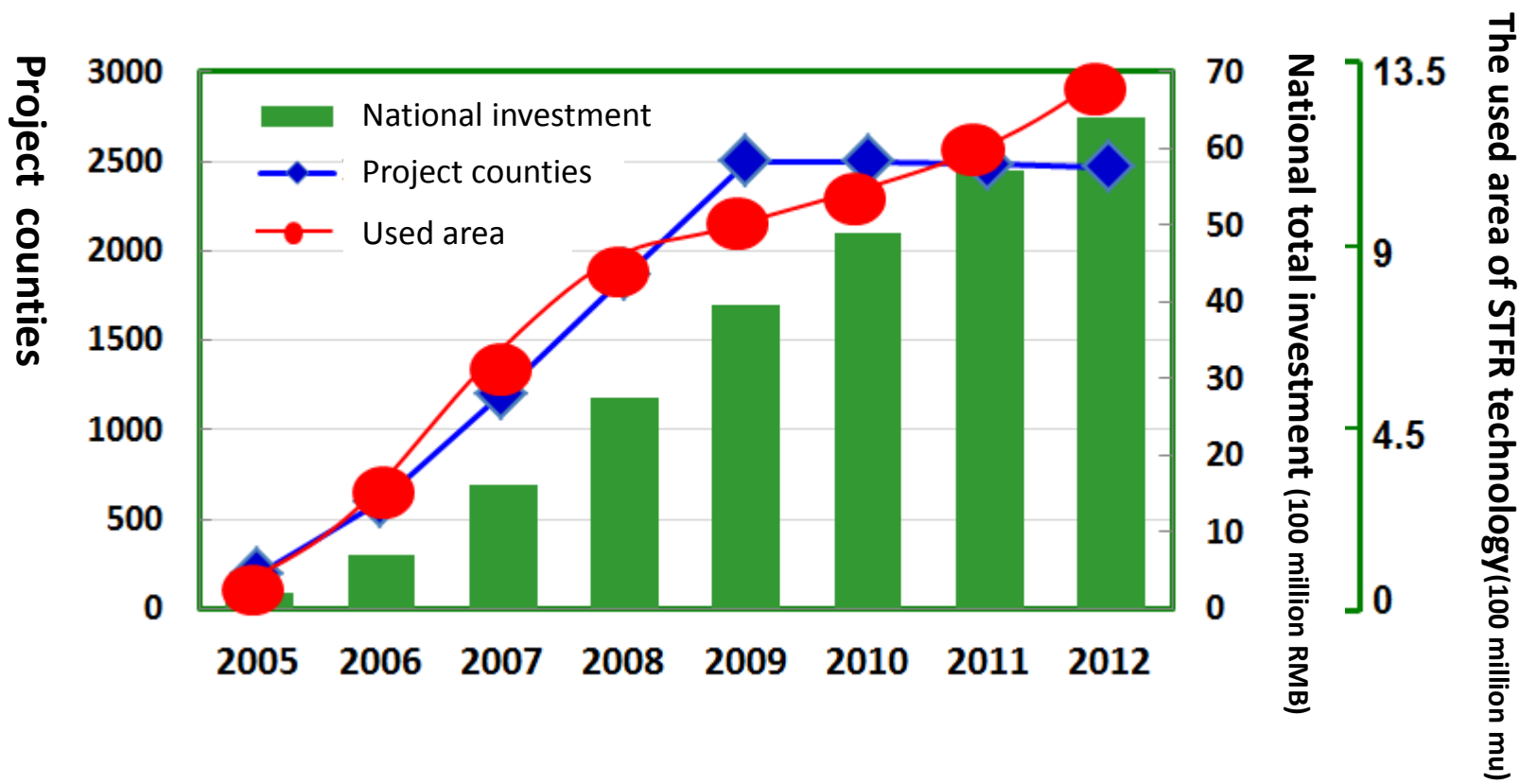
Crop land management

- Right amount-balance crop demand
- Right place-Deep placement
- Right time-use in crop fast growth period
- Right products- in cooperate NH₃ and NO₃
- Recycling organic nutrients

Integrated industry and Crop land management

Improvement in technology and policy

National action of nutrient management



Improvement in technology and policy

More and more farmers received government services.

Farmers who got government services (%)		
	2008 (n=1103)	2013 (n=1919)
Farmers who aware of soil testing	80	88
Farmers whose soil has been tested	34	71
Farmers who got the result of soil testing	22	52
Farmers who got recommendation card	52	52
Farmers who got suggestions from consultant	59	81
Farmers who got training	34	63
Farmers who got online service	4	8

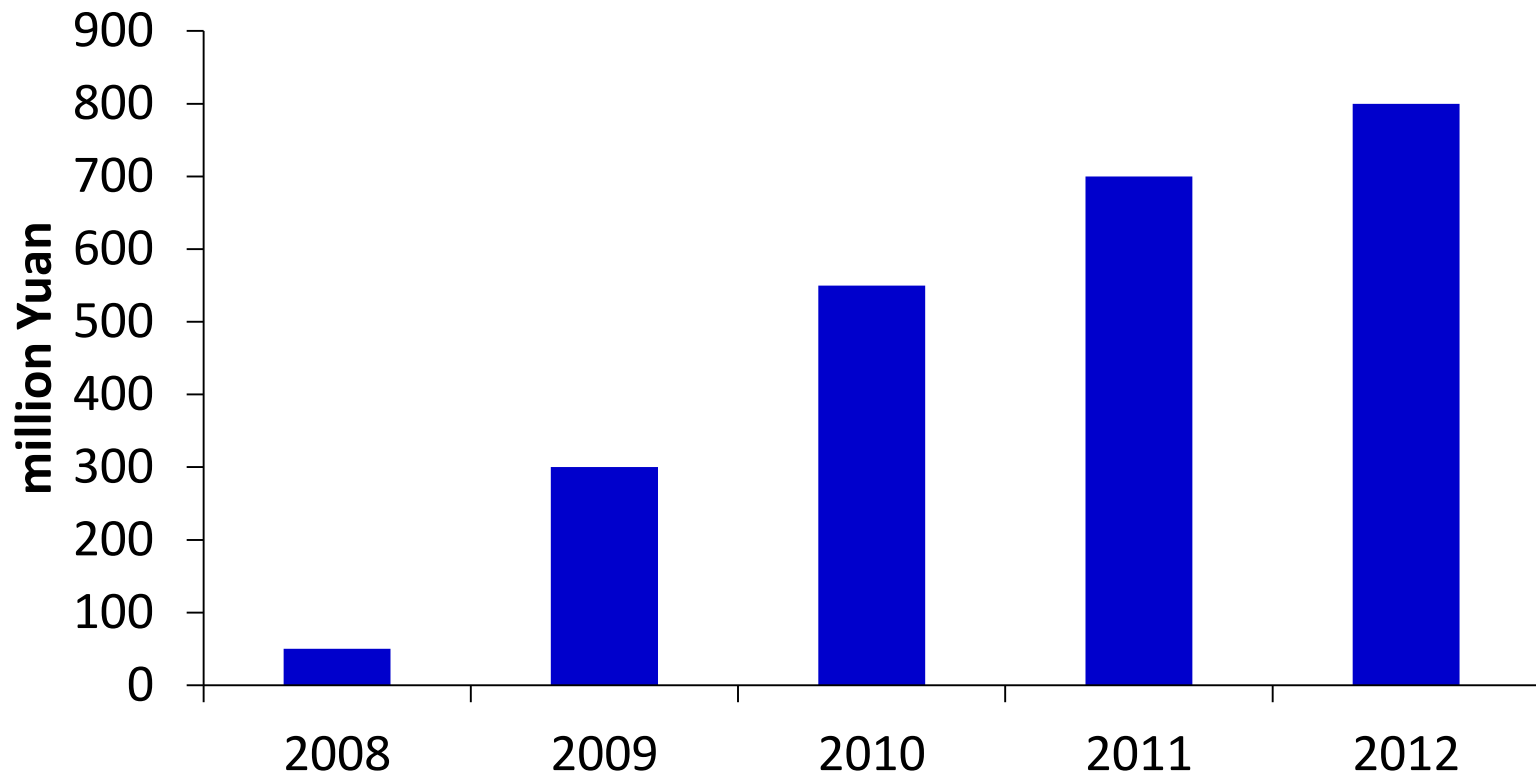
Improvement in technology and policy

Services significantly improved farmers knowledge and practices.

	Farmers who do not know soil testing	Farmers who know soil testing			
		but did not try soil test and train	Only got training	Only tried soil testing	Tried Soil testing and got training
Samples	N=181	N=326	N=201	N=415	N=796
Farmers can recognize NPK labeled on fertilizer bag (%)	19	34	43	46	56
Farmers can judge the nutrient content of fertilizer (%)	30	47	55	54	65
Farmers who can calculate nutrient demand for crop (%)	13	25	27	34	51
Farmers know fertilizer have environment risk(%)	38	52	56	63	73
Farmers with rational application rate (%)	41	40	42	49	47

Improvement in technology and policy

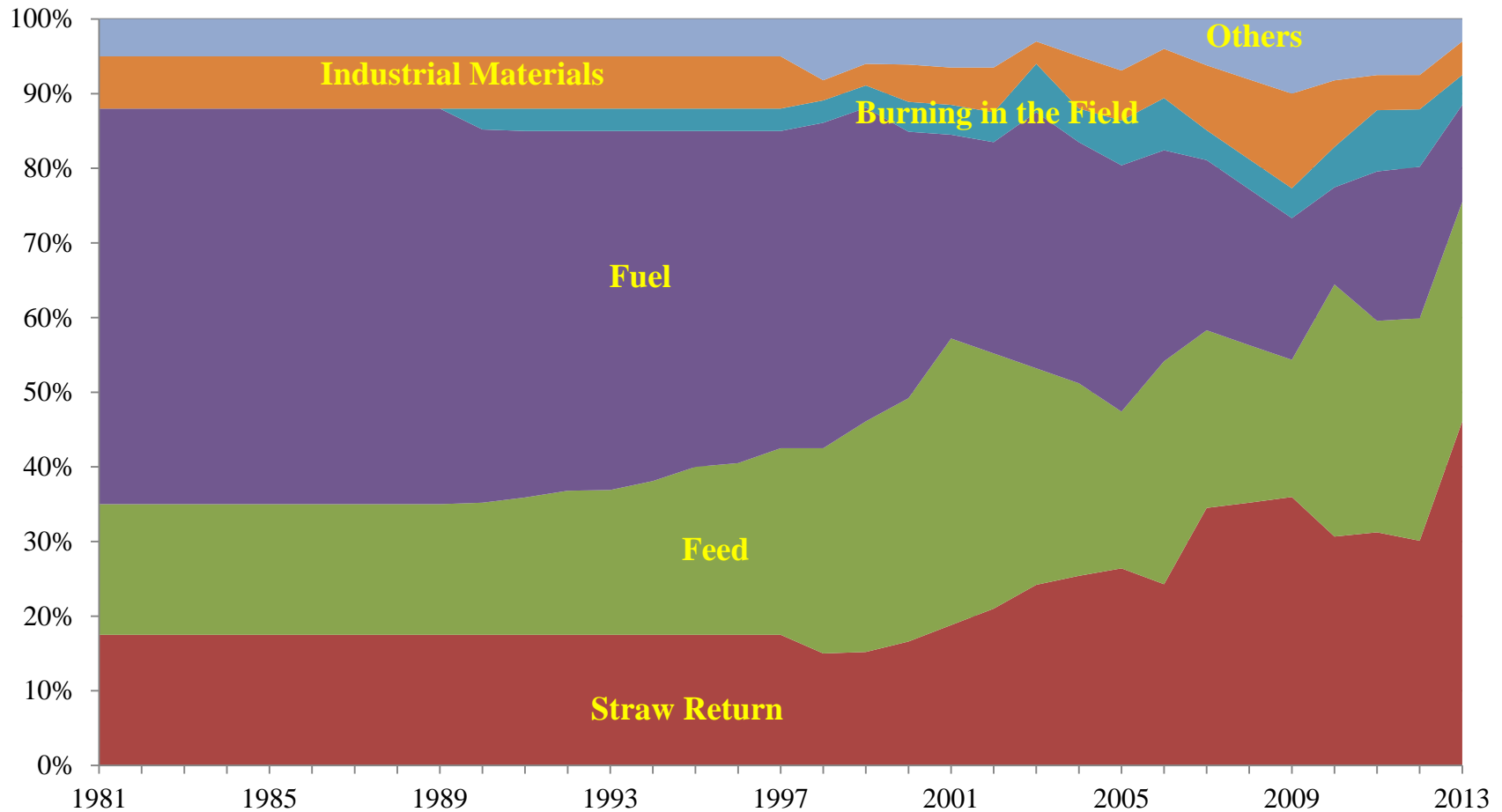
Subsidies to increase soil organic matter



Government investment for soil organic matter improvement

Improvement in technology and policy

Fast development in returning of crop straw into field



Improvement in technology and policy

Subsidies for foliar application of fertilizers

Special subsidies for foliar application of fertilizer on winter wheat in later growth stage to defend heat\ logging and increase yield.

In 2012, 800 million Yuan for winter wheat;

In 2013, 1700 million Yuan for winter wheat.

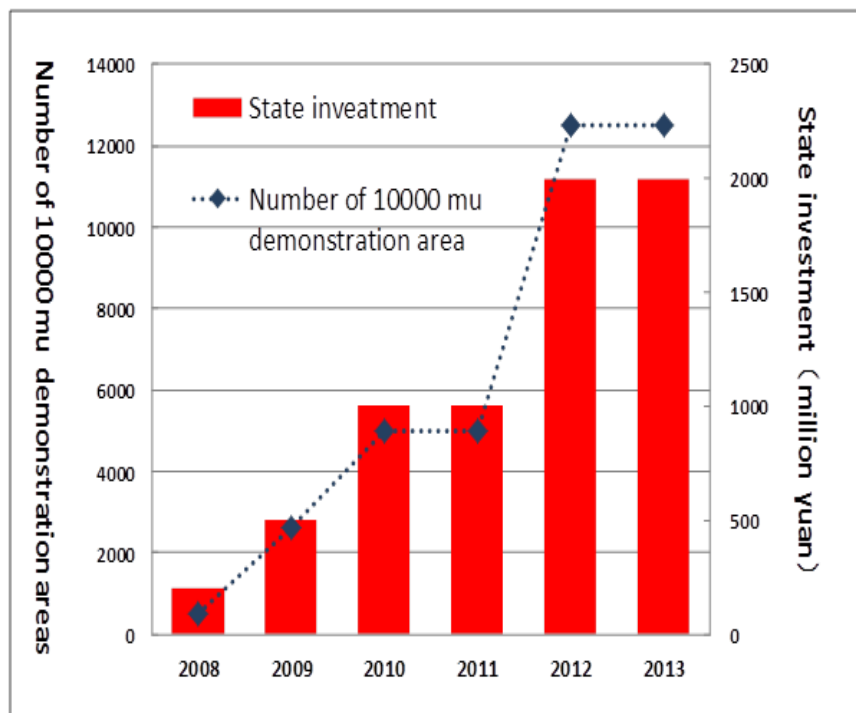


Photo from Jingyuan Xia

Improvement in technology and policy

National action on high yielding grain, cotton, oil and sugar crop production

In last 6 years, totally 6.7 billion RMB has been invested to set up 12500 “10000 mu demonstration areas” .



Unit (t/ha)

Crops	Target yield	Farmers' practice	Increase rate(%)
Spring maize	12	7.6(1118)	58%
Summer maize	10.5	6.9(1709)	52%
Single rice	10.5	7.9(927)	33%
Double rice	13.5	12.6(1159)	7%
Irrigated wheat	9	6.6(1252)	36%
Dryland wheat	6	3.7(1192)	62%

Note: 10000 mu=667 hectare; Farmers' practice from farmer survey, including 7357 households in 2008-2009.

Improvement in technology and policy

Government encourage farmers cooperatives organization development since 2006.

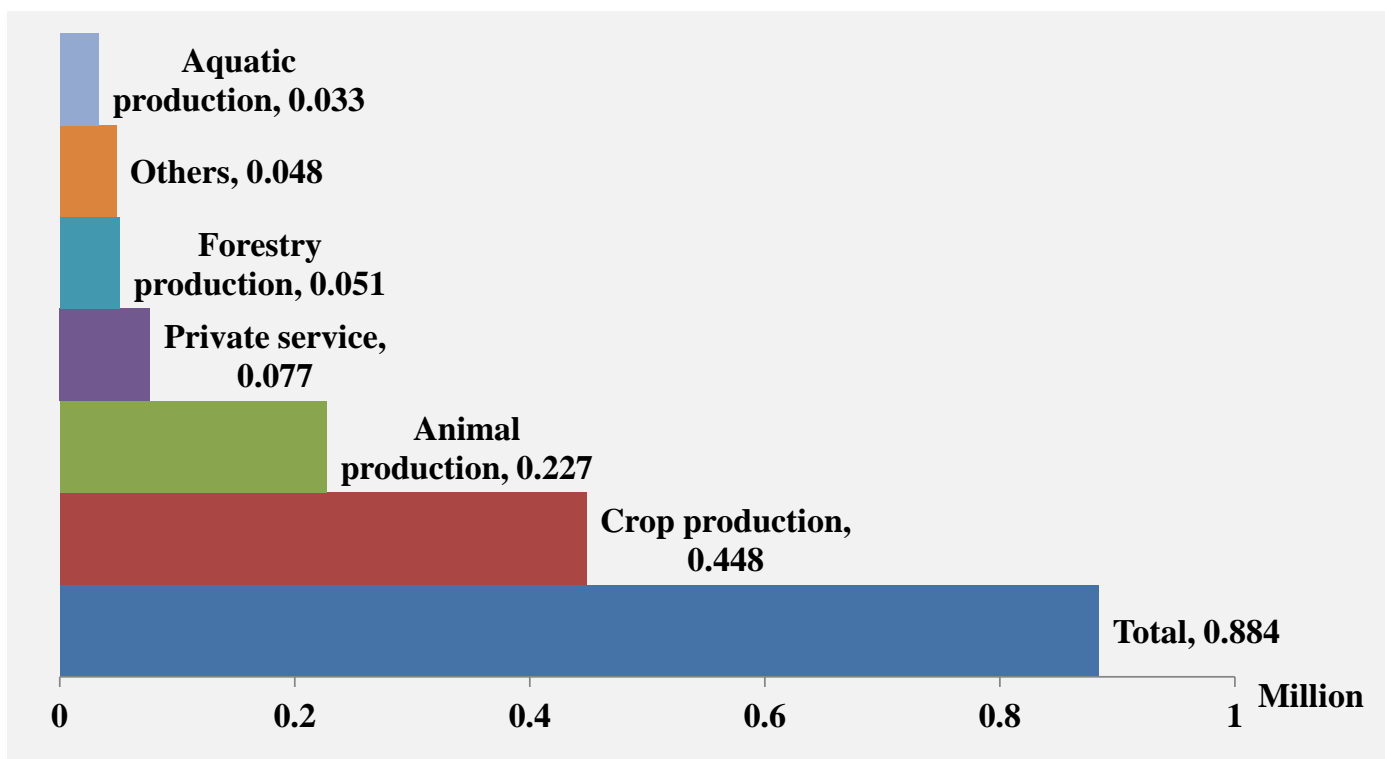
Some regional subsidies have been launched to push forward

Regions	Requirement	Subsidies
Tengzhou, shandong province	>50 mu	100 Yuan/ mu to landlord
	50~100 mu	100 Yuan/ mu to tenant
	100-300mu	200 Yuan/ mu to tenant
	>300 mu	300 Yuan/ mu to tenant
Wuhan, Hubei province	≥1000 mu	50 Yuan/ mu to tenant
Nanning, Guangxi province	≥500 mu	200Yuan/ mu to tenant
Jiaxing, zhejiang province	≥ 100mu, more than 5 year	200Yuan/ mu to tenant
	≥300mu, new farmer cooperatives	20000 Yuan/ household

Improvement in technology and policy

Small subsistence farmers are merging into bigger one

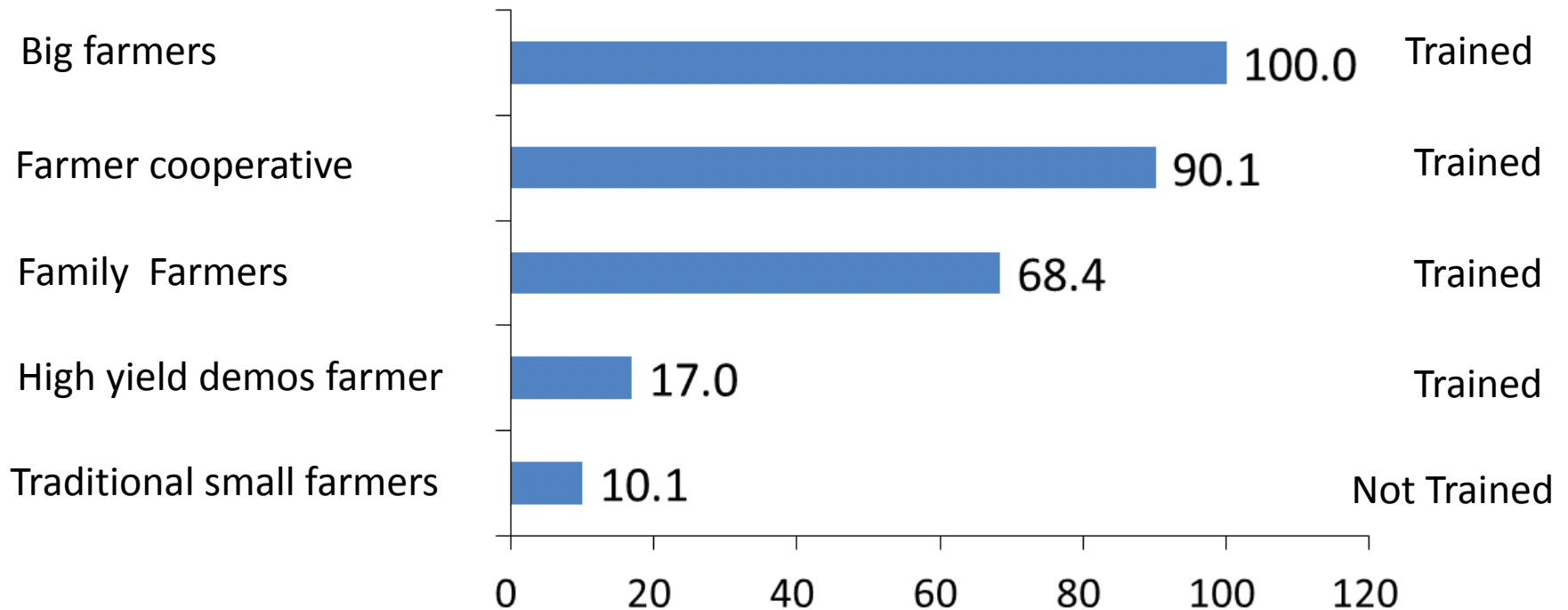
26% of land transferred into 884 thousand farmer cooperatives, 877 thousand family farms, and 2.87 million big farms (>3 ha) in China at the end of 2013



Number of various kinds of farmer cooperatives in China

Improvement in technology and policy

Enlarging land size and on-time training helps better use of fertilizer.



Adoption rate of precision topdressing during April 1st to 15th

Wang wenke, unpublished

Improvement in technology and policy

Subsidies for machinery related to fertilizer application



Subsidy about 30% of price



Subsidy for well construction, facilities

Improvement in technology and policy



Broadcasting by hand

Fertilizer broadcasting by hand resulted in low use efficiency, over fertilization and environmental risk



Bigger machine sowing and fertilization



Manpower sowing

Labor intensive, lower quality of seeding



Small machine sowing

More seeds applied, but lower quality of seeding.



Bigger machine sowing

High efficiency, less seeds applied, high quality of seeding, and high crop yield.



Seeding stage



Seeding stage

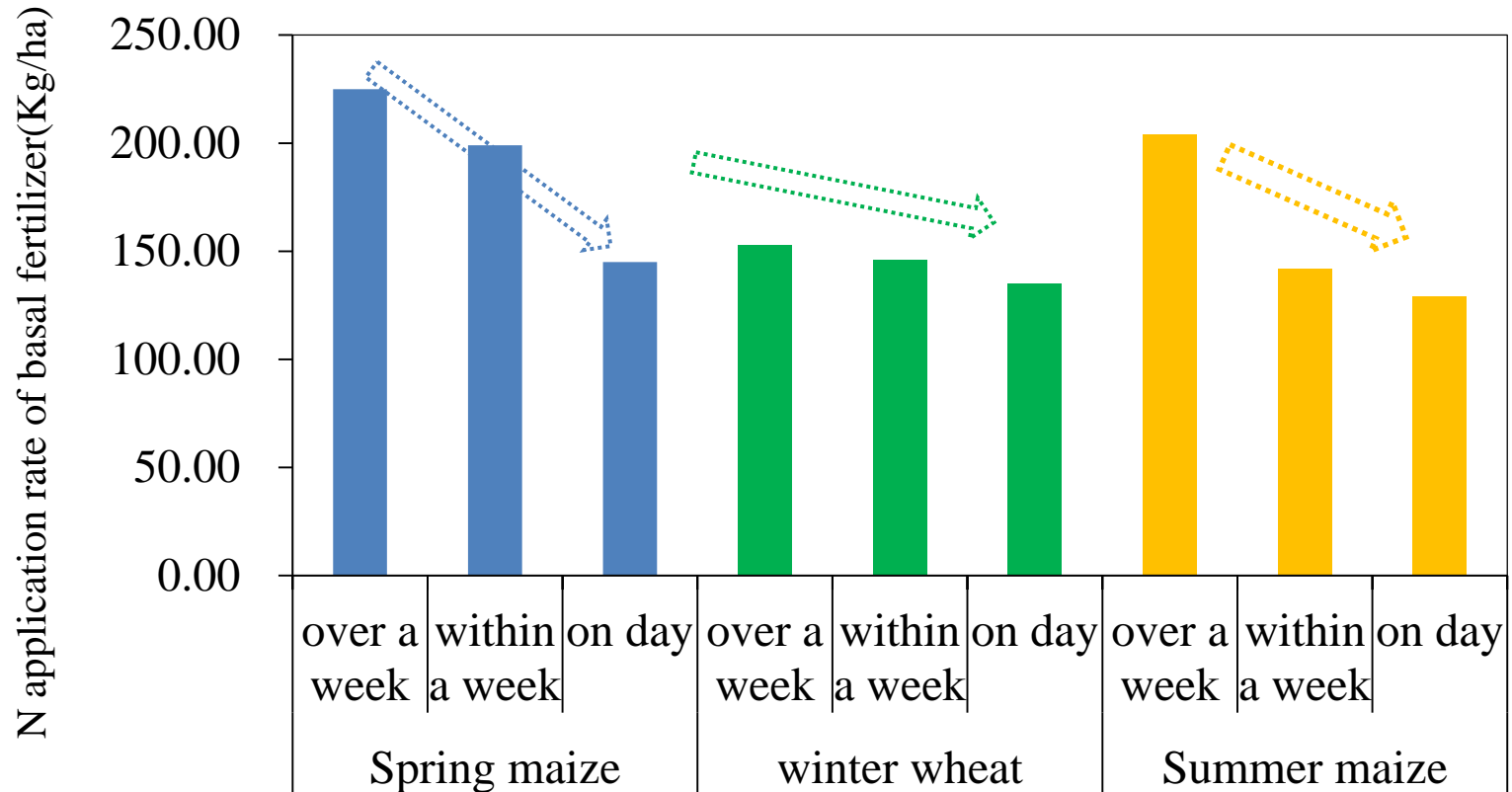
Improvement in technology and policy

Farmers who adopted mechanized application of fertilizer(%)

Crops	2008(n=1152)			2013(n=2112)		
	Starter fertilizer	Basal fertilizer	Top dressing	Starter fertilizer	Basal fertilizer	Top dressing
Spring maize	0	55	0	100	65	2
Winter wheat	70	3	1	100	36	5
Sumer maize	80	3	0	100	62	11
Single rice	0	2	0	0	4	1
Early rice	0	0	0	0	3	0
Later rice	0	0	0	0	3	0
Average of grain	34	12	1	65	35	4

Improvement in technology and policy

Usage of fertilizer too early than crop sowing resulted in too much of fertilizer input

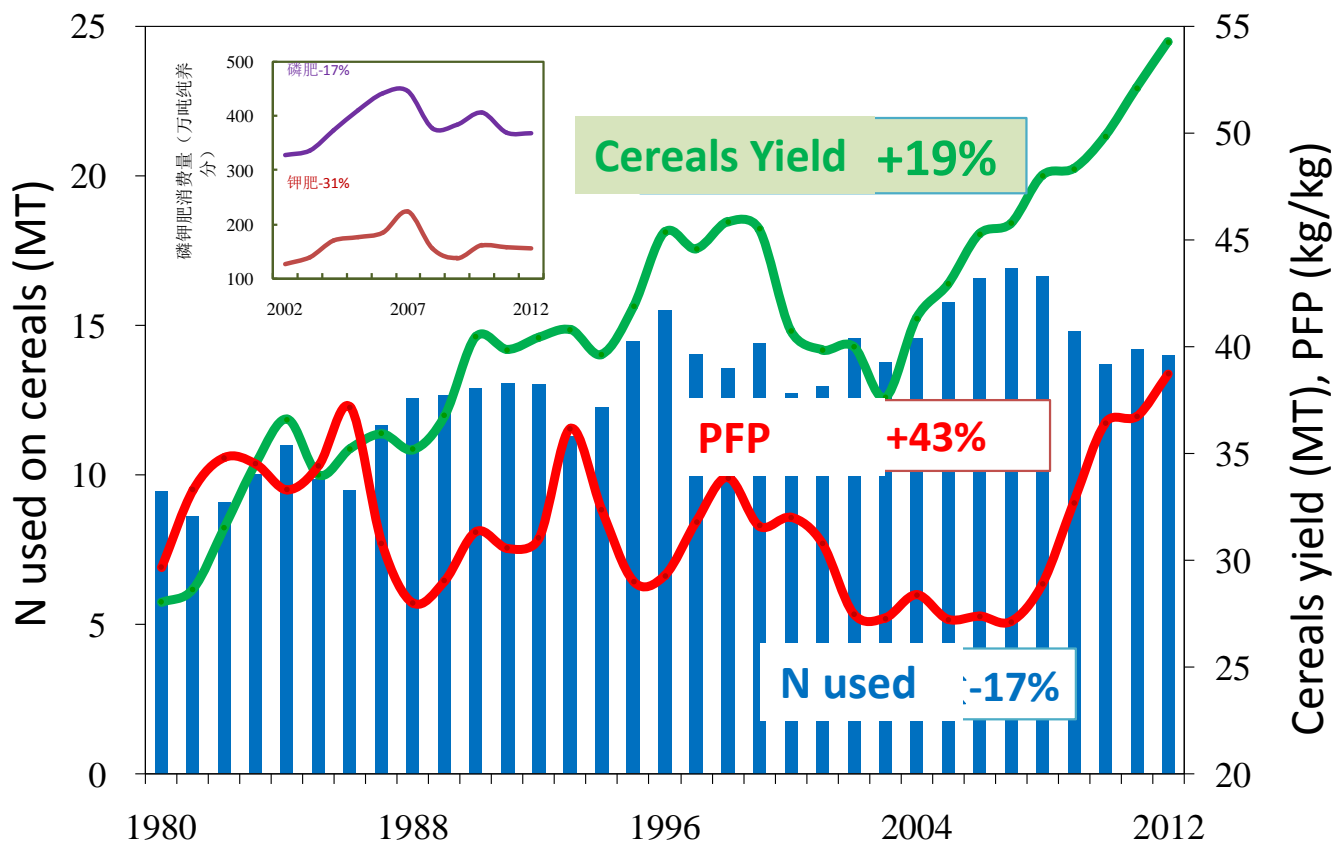


The difference of N application rate when farm use it on different time

Improvement in technology and policy

Enhanced fertilizer use efficiency on grain crops

During 2007-2012, cereals yield increased by 19% while N, P₂O₅, K₂O application rate decreased by 17%、17%、31%, PFP_N increased by 43%



Improvement in technology and policy

Enhanced fertilizer use efficiency on grain crops

There is small increase of AE on N but high increase on P and K

Changes of agronomy efficiency of fertilizer on main grain crops

	Crop	2000-2005			2006-2010		
		Application rate (kg/hm ²)	Yield (T/hm ²)	AE (kg/kg)	Application rate (kg/hm ²)	Yield (T/hm ²)	AE (kg/kg)
Nitrogen	Rice	149	6.8	10.4	170	8.0	12.7
	Wheat	170	5.7	8.0	179	6.3	10.7
	Maize	163	7.0	9.8	183	8.8	11.9
Phosphate	Rice	72	5.9	7.4	61	7.1	23.3
	Wheat	95	4.7	8.1	95	5.8	15.1
	Maize	116	7.7	9.1	83	8.6	17.4
Potash	Rice	106	5.9	4.9	88	7.2	16.5
	Wheat	136	5.3	4.5	90	5.9	14.1
	Maize	126	7.6	4.4	83	7.7	12.4

Zhang et al.,2013 《national fertilizer development report, 2012》

Improvement in technology and policy

Enhanced fertilizer use efficiency on grain crops

There is small increase of RE on N and K, but high increase on P

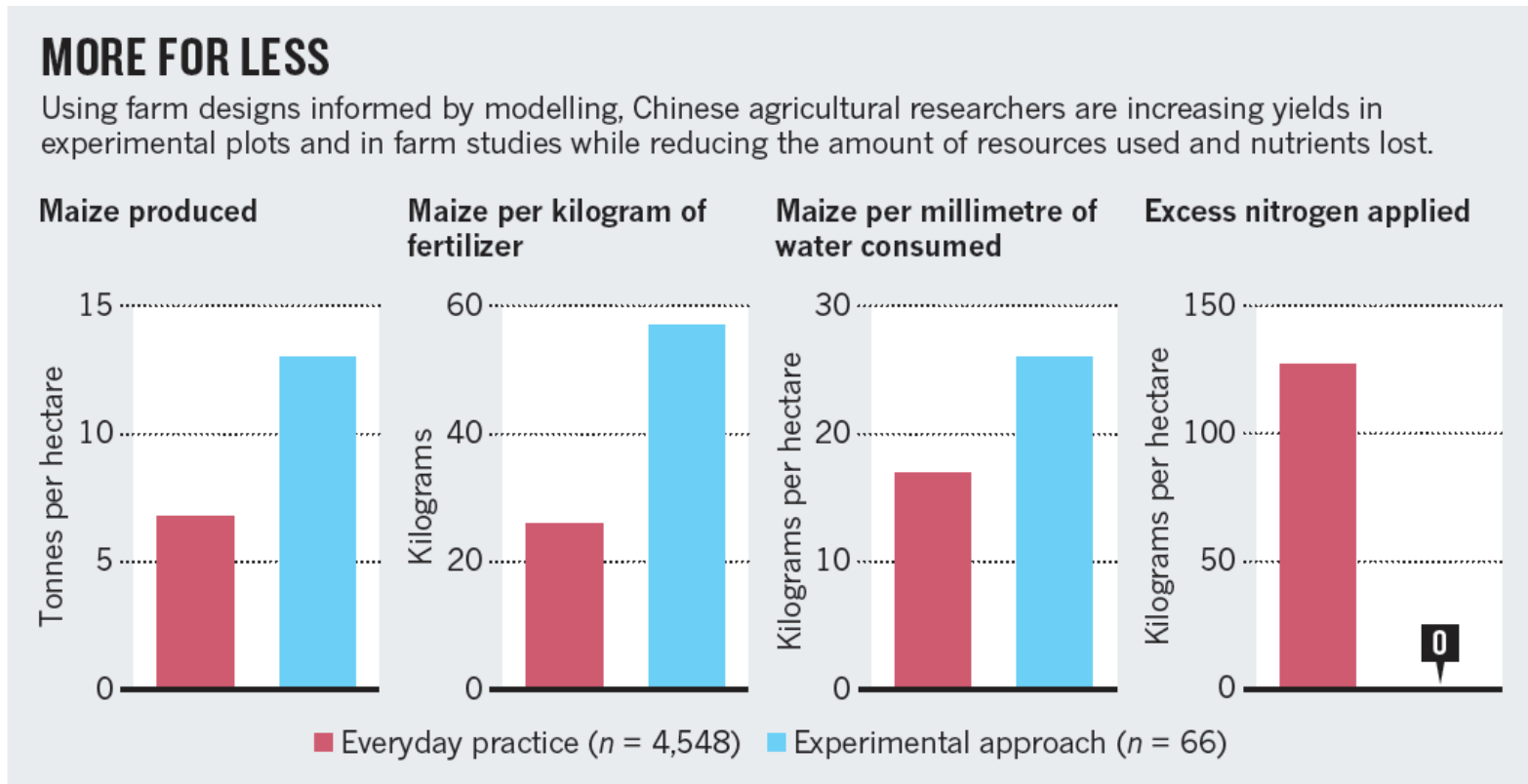
Recovery efficiency of fertilizer on main cereals crops

Period	Crops	Fertilizer use efficiency (RE, %)			Source
		Nitrogen	phosphate	Potash	
2011-2012	Wheat	32.0	19.2	44.4	MOA
	Maize	32.0	25.0	42.8	
	Rice	34.9	24.6	41.1	
2001-2005	Wheat	28.2	10.7	30.3	Fusuo Zhang.,2008
	Maize	26.1	11.0	31.9	
	Rice	28.3	13.1	32.4	
2002-2005	Wheat, maize, rice	28.7	13.1	27.3	Academy of agriculture science, 2008
1981-1983	Wheat, maize, rice	30-35	15-20	35-50	Zhu, 2002

Zhang et al.,2013 《national fertilizer development report, 2012》

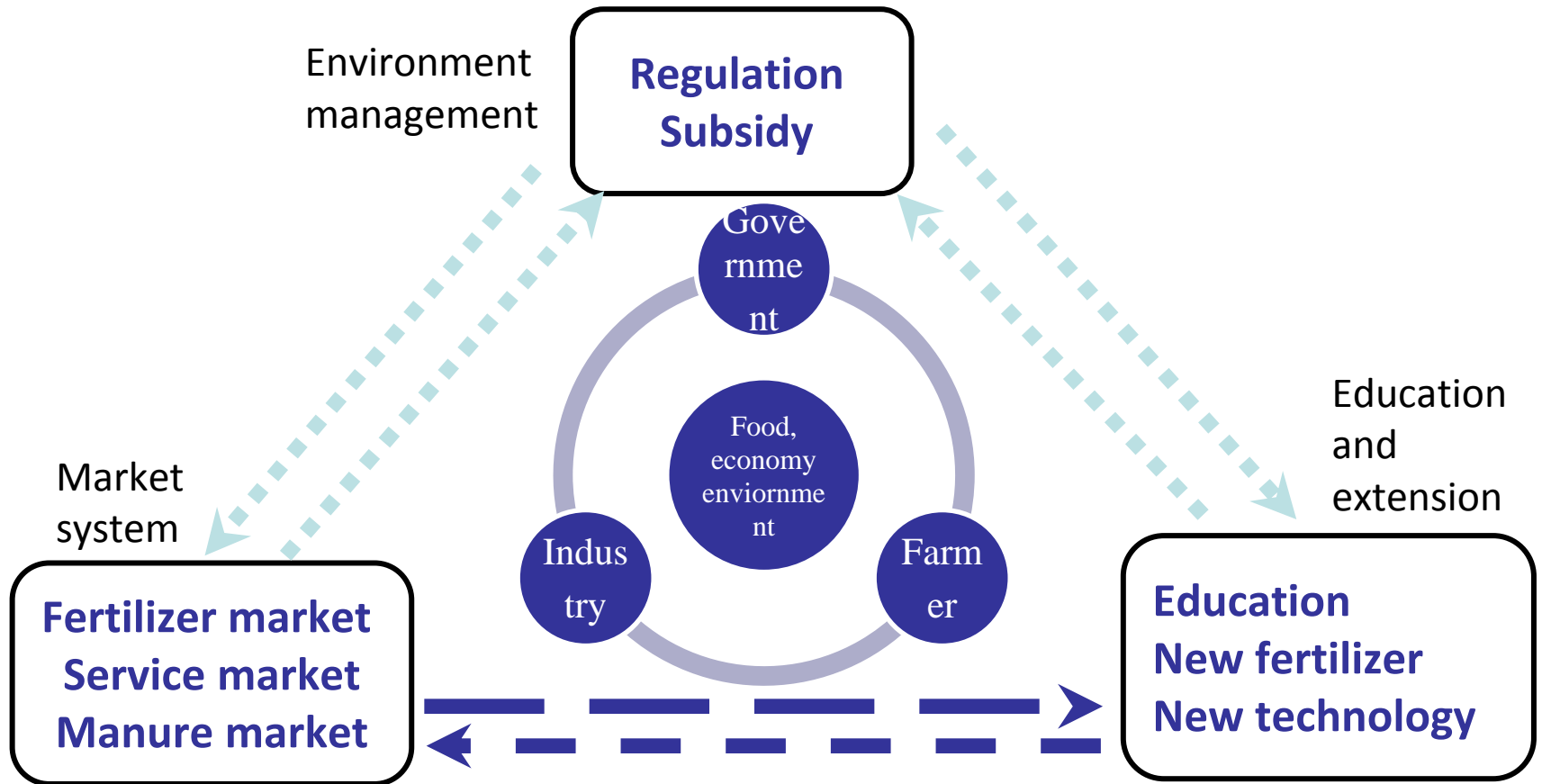
Challenge and perspective

We have a big potential and possibility to increase crop production, resources use efficiency with low environmental risk, but how to realize it at national scale?



Challenge and perspective

It is a big challenge to build up an integrated nutrient management scheme in China



Challenge and perspective

Market reform should supported by strong legislation and better service.

Why farmers test fertilizer by mouth?

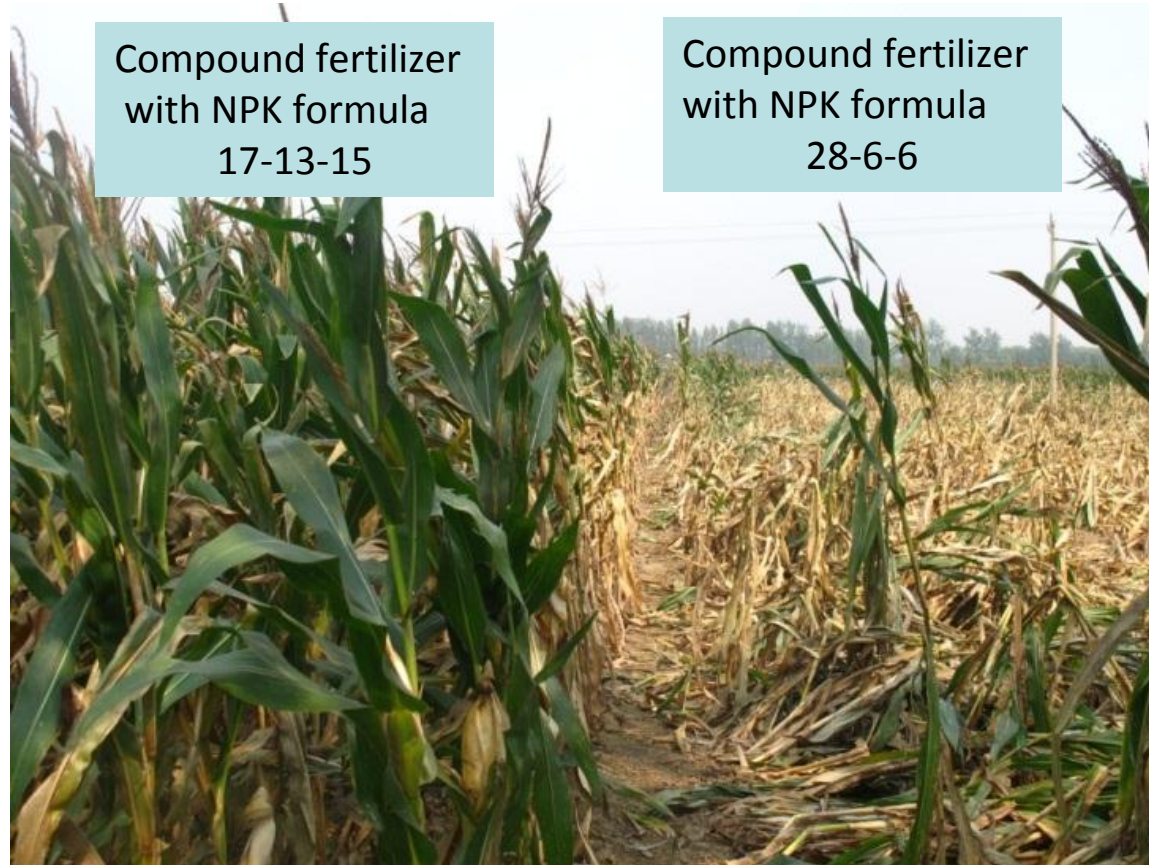
- ① No fertilizer law to standardize fertilizer quality.
- ② Farmers' knowledge is not enough to find other ways to distinguish true products.
- ③ No government services are available till date.



Challenge and perspective

Wrong products with wrong application method resulted in 20% more fertilizer input with no increase in crop yield.

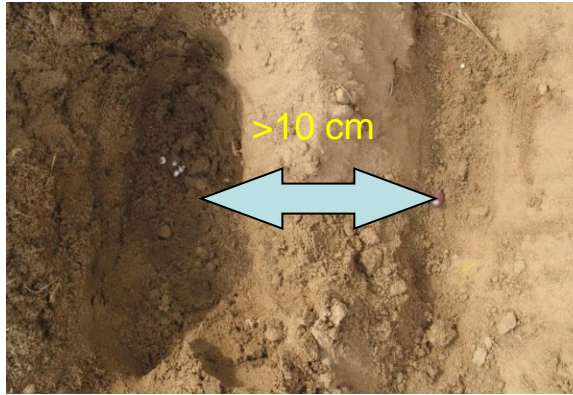
Better cooperation between fertilizer industry and agriculture is emergent required for food security and environmental safety .



Challenge and perspective

Integrated innovation of machines, fertilizer products, and crop management are required to improve NUE in mechanized fertilization practice.

- Poor land preparation
- Machine did not match crop production system
- Fertilizer is easy to stick and block the pipe
- Machines are expensive for small farmers
- Farmers do not like to spend time on top dressing





Data Source: China Fertilizer Market Week

Thanks !