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Current situation, trend and outlook for nitrogen use efficiency in China

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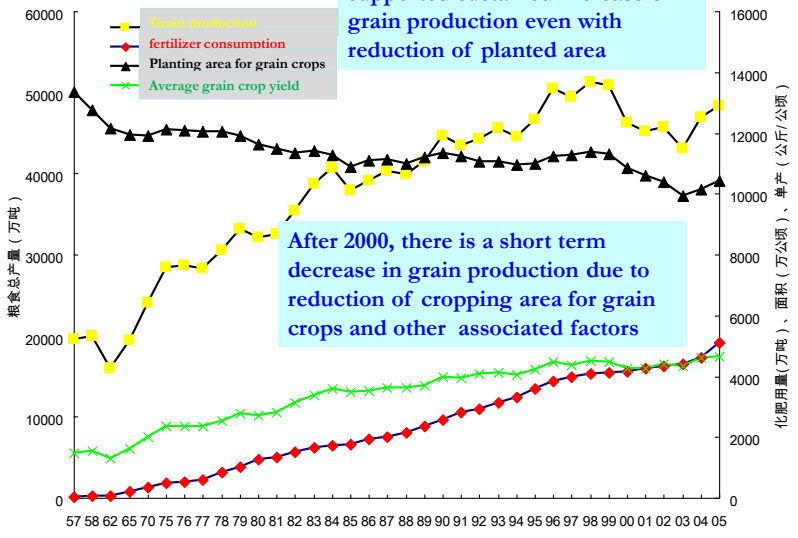
- China has large population and limited arable land resource
- 2/3 of China's arable land is low-moderate productivity
- Cropping systems on most arable land are highly intensified

Fertilization is very important for both increasing crop production and build up soil fertility and land productivity, and with time, highly intensified crop systems developed in China with high nutrient input and high output

Fertilizer use, grain production and yield in China

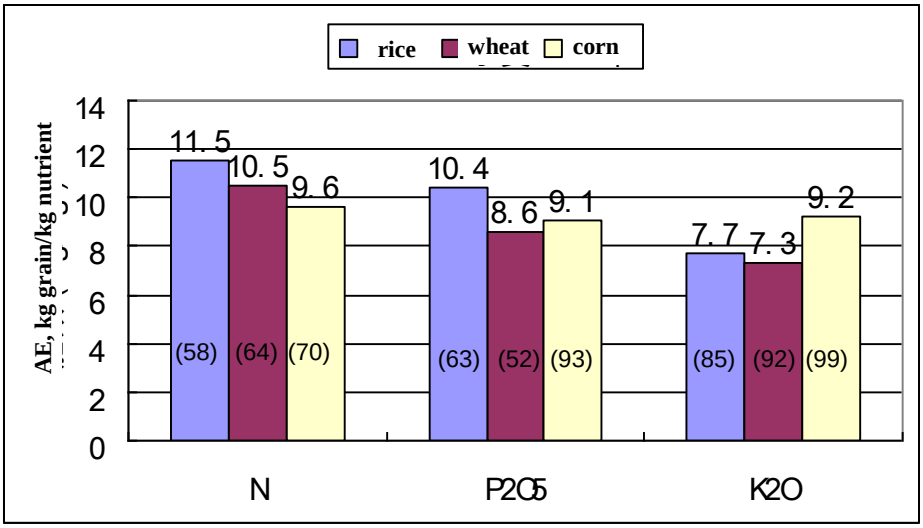


2008: China Released "Mid and Long Term Plan to Ensure Food Security in China"

- **By 2020, grain production reach 540 million tonnes**
- **95% of grain will be produced domestically**

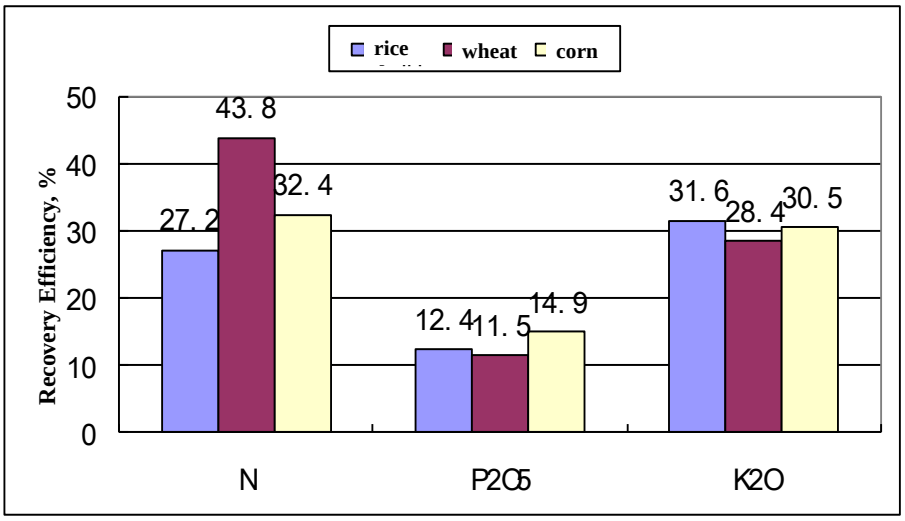
Food security and "3-Nong" (agriculture production, rural development and farmers' income) are the long term strategy of China

Agronomic Efficiency of N, P, K in rice, wheat and corn
IPNI Cooperative network, 2002-2007



Number in parenthesis is the number of field trials for the nutrient study and that crop

N, P and K recovery efficiency by 1st crop of rice, wheat and corn (%)



IPNI Network, 2002-2005

Table 5. Average nitrogen use efficiency terms for cereals in different world regions: Literature summary of field trials conducted at research stations and averages of selected on-farm studies.

Region/crop	N rate	RE_{15N}	RE_N	PE_N	AE_N	PFP_N
	kg/ha	----------	----------	kg/kg	----------	----------
Research station trials (stationary treatment plots)[1]						
Africa	139	0.37	0.63	23	14	39
Europe	100	0.61	0.68	28	21	50
America	111	0.36	0.52	28	20	50
Asia	115	0.44	0.50	47	22	54
Average		0.44	0.55	41	21	52
Maize (rainfed & irrigated)	123	0.40	0.65	37	24	72
Rice (irrigated)	115	0.44	0.46	53	22	62
Wheat (rainfed and irrigated)	112	0.45	0.57	29	18	45
On-farm studies (non-stationary treatment plots)						
Maize, USA (rainfed & irrigated)[2]	158	-	0.36	33	12	61
Maize, USA (irrigated)[3]	142	-	0.57	41	23	94
Maize, Indonesia (rainfed & irrigated)[4]	200	-	0.37	46	17	46
Rice in S, E and SE Asia (irrigated)[5]	117	-	0.31	39	12	49
Rice in West Africa (irrigated)[6]	106	-	0.36	47	17	46
Wheat in North India (irrigated)[7]	134	-	0.34	32	11	44

RE_{15N} – average N recovery efficiency measured with the ^{15}N isotope dilution method. All other N use efficiency terms – difference method, as described in Table 1.

Dobermann, 2007

1st crop recovery of N fertilizer by grain crops

Crop	Region	N rate	RE_N
	(No. of obs.)	(kg N ha^{-1})	(%)
Maize, trials[1]	World (36)	102	63
Maize, on-farm[2]	USA (55)	103	37
Rice, trials[1]	World (307)	113	44
Rice, on-farm[3]	Asia (179)	117	31
Wheat, trials[1]	World (507)	117	54
Average trials[1]	World (850)	-	51

1 Ladha et al. (2005); 2 Cassman et al. (2002); 3 Dobermann et al. (2002)

- **N rate used in "World" trials: 102 - 117kg/ha**
- **N rate used in trials in China: 188 - 224 kg/ha which is related to relatively low fertility of the soil, and demand for high yield**

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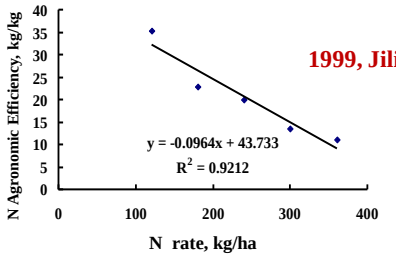
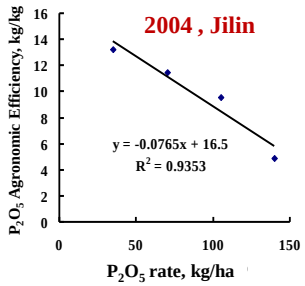
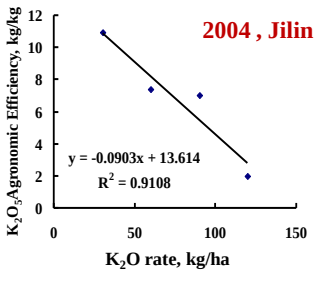
Effect of fertilization rate on AE with corn

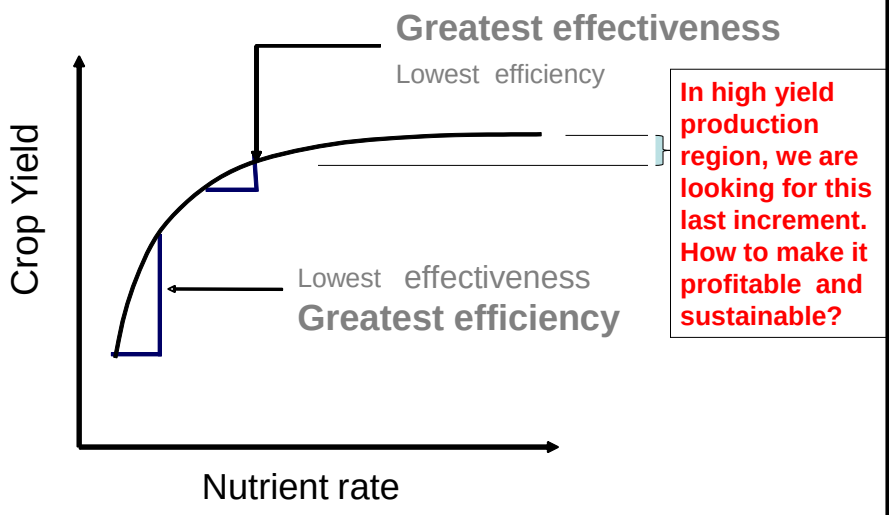
With increase of application rate, AE of N, P and K decreased







Law of diminishing returns



1. **Agronomic efficiency (AE) of grain crops in China is still following the order: N>P>K;**
1. **N fertilizer is still driving force for further increase in crop yield and crop production**
2. **Agronomic efficiency and recovery efficiency of N is relatively low in China;**
3. **The low N efficiency in China is due to high N rate for high yield production, and improper use of fertilizers;**
4. **It is important to further improve fertilizer use efficiency in China for sustained increase of crop production;**
5. **With the highly intensified cropping systems in China, further improvement of fertilizer use efficiency is a big challenge, but can be done with advances in fertilization related science and technology.**

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Drip fertigation under plastic mulch increased N use efficiency in Xinjiang

Year	Site and crop	Treatment	Fertilizer rate (kg/ha)			Yield	N uptake by crop	N recovery efficiency %
			N	P_2O_5	K_2O			
2007	Manas Tomato	OPT-N	0	150	150	63733	139.3	
		OPT	270	150	150	91680	300.4	59.7
2008	Manas Tomato	OPT-N	0	120	105	44447	113.3	
		OPT	300	120	105	95259	313.7	66.8
2009	Bole Maize	OPT-N	0	105	45	10685	202.6	~
		OPT	225	105	45	15504	305.7	45.9
		OPT+M	225	105	45	19055	324.8	54.3
		FP	307.5	135	0	15353	304.9	33.3

Note：OPT is drip fertigation with recommended rates；FP is farmers practice；M is cattle manure at 30000kg/ha

Source, Zhang Yan, 2010

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