



N2010

NITROGEN FERTILIZER USE AND GRAIN PRODUCTION IN CHINA

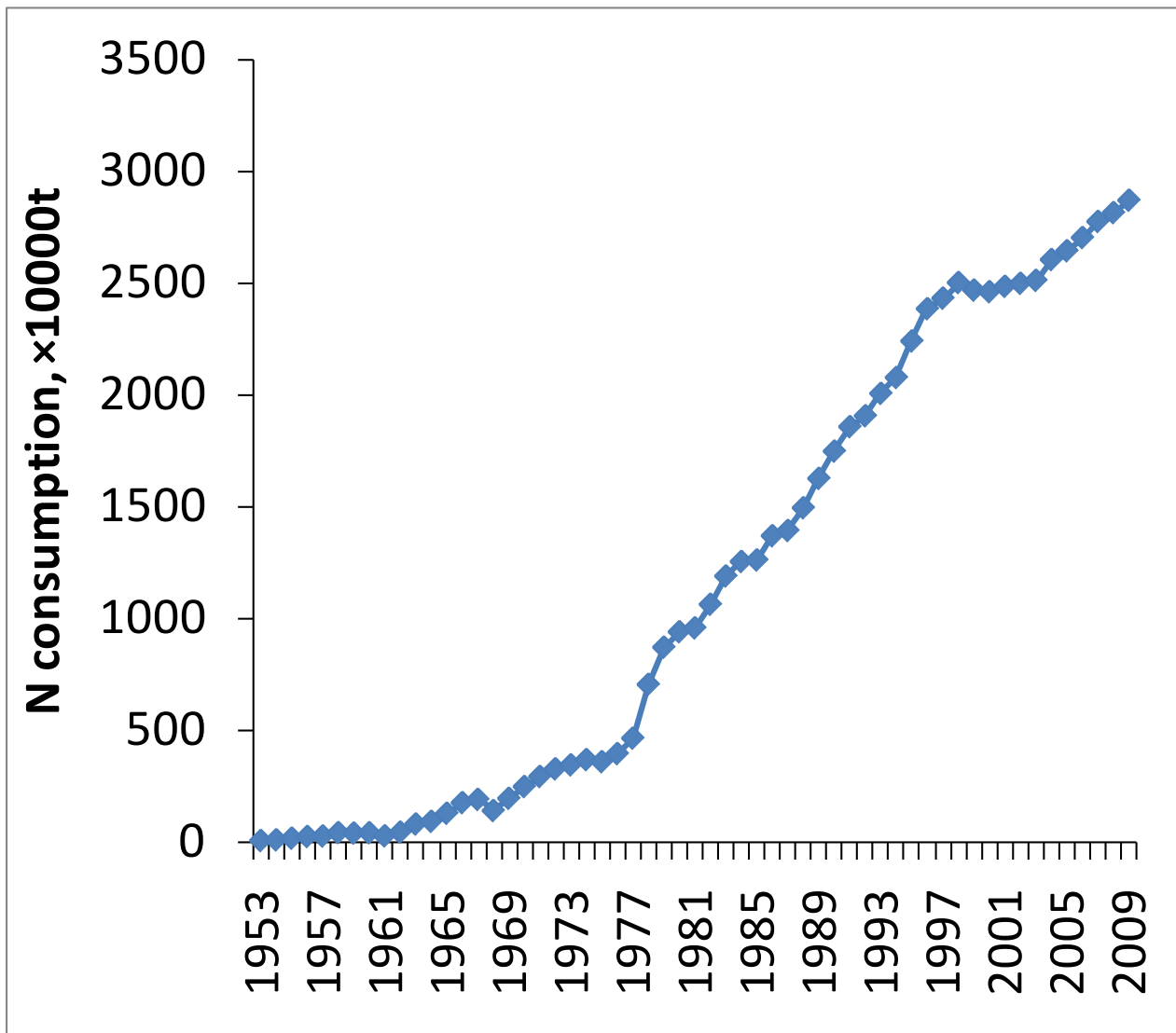
Shutian LI, Jiyun JIN
IPNI China Program

Dec. 5, 2010, New Delhi

Fertilizer N consumption

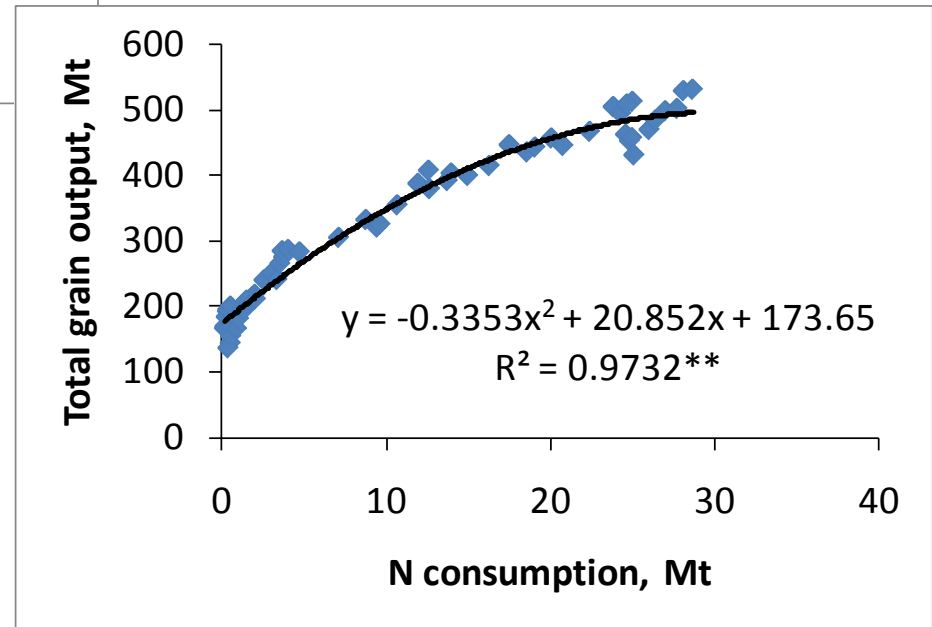
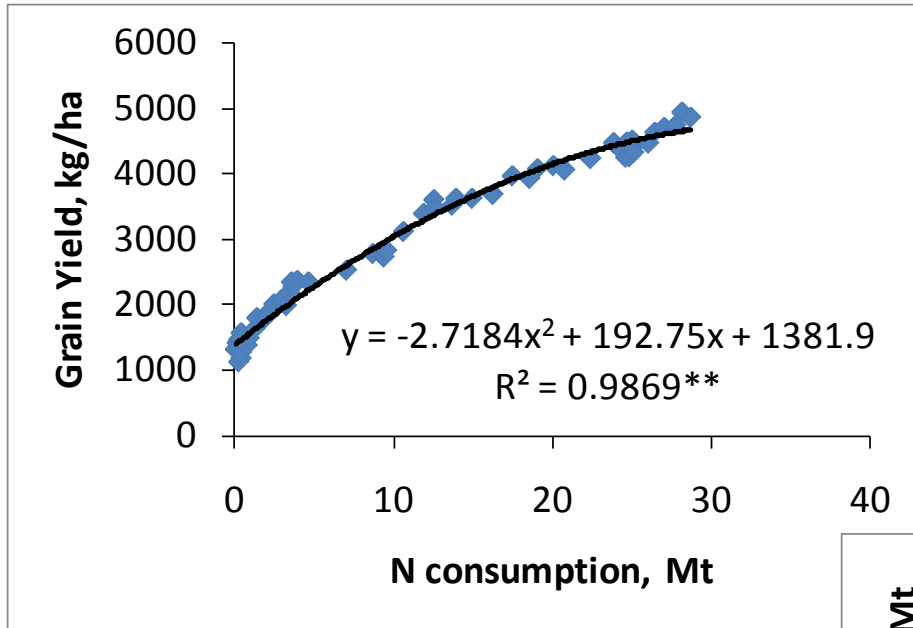


Fertilizer N consumption from 1953 to 2008



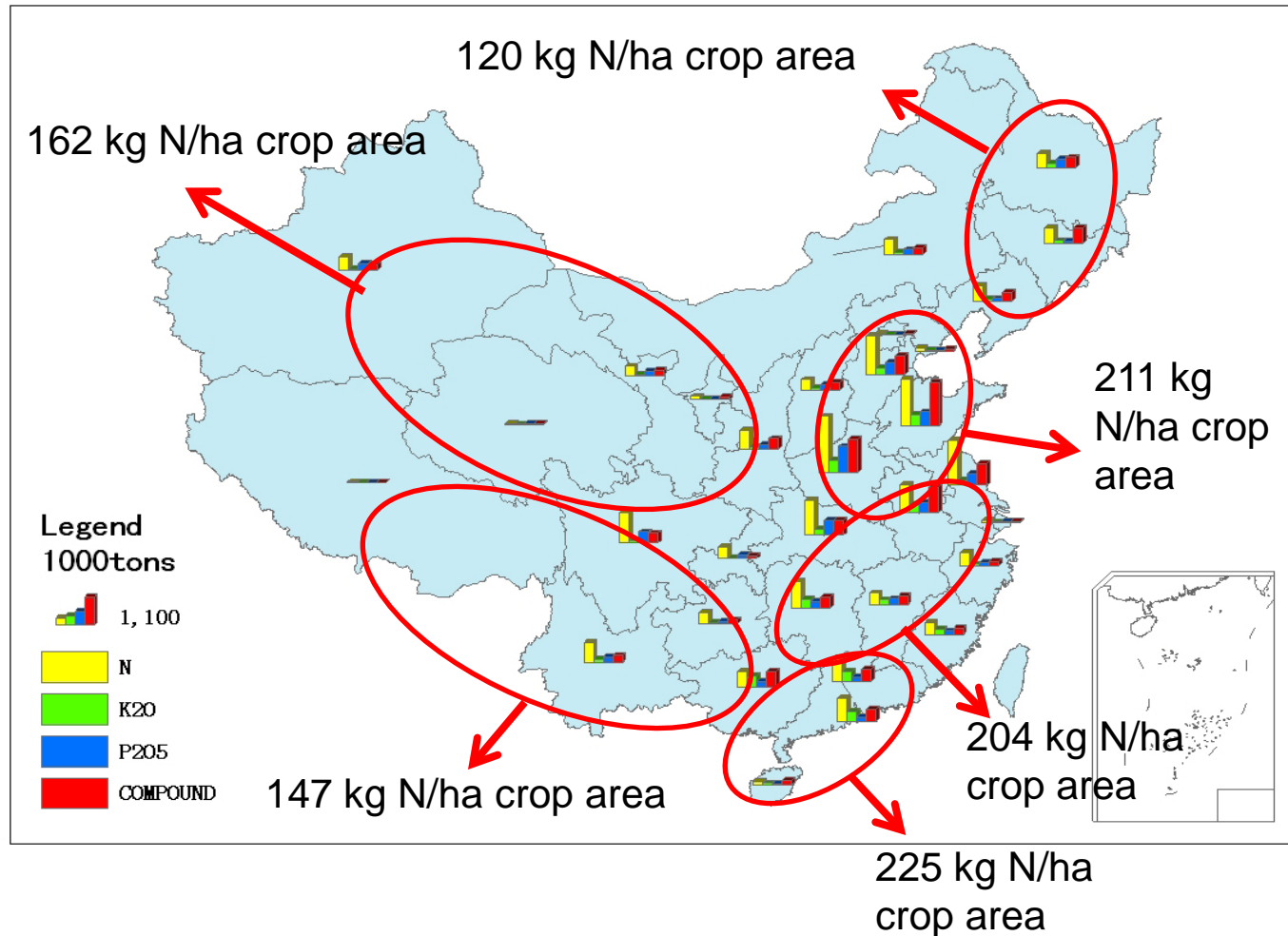
Source: China
Agriculture
Year Book

Relationship between N consumption and grain yield



Based on China Agriculture Year Book

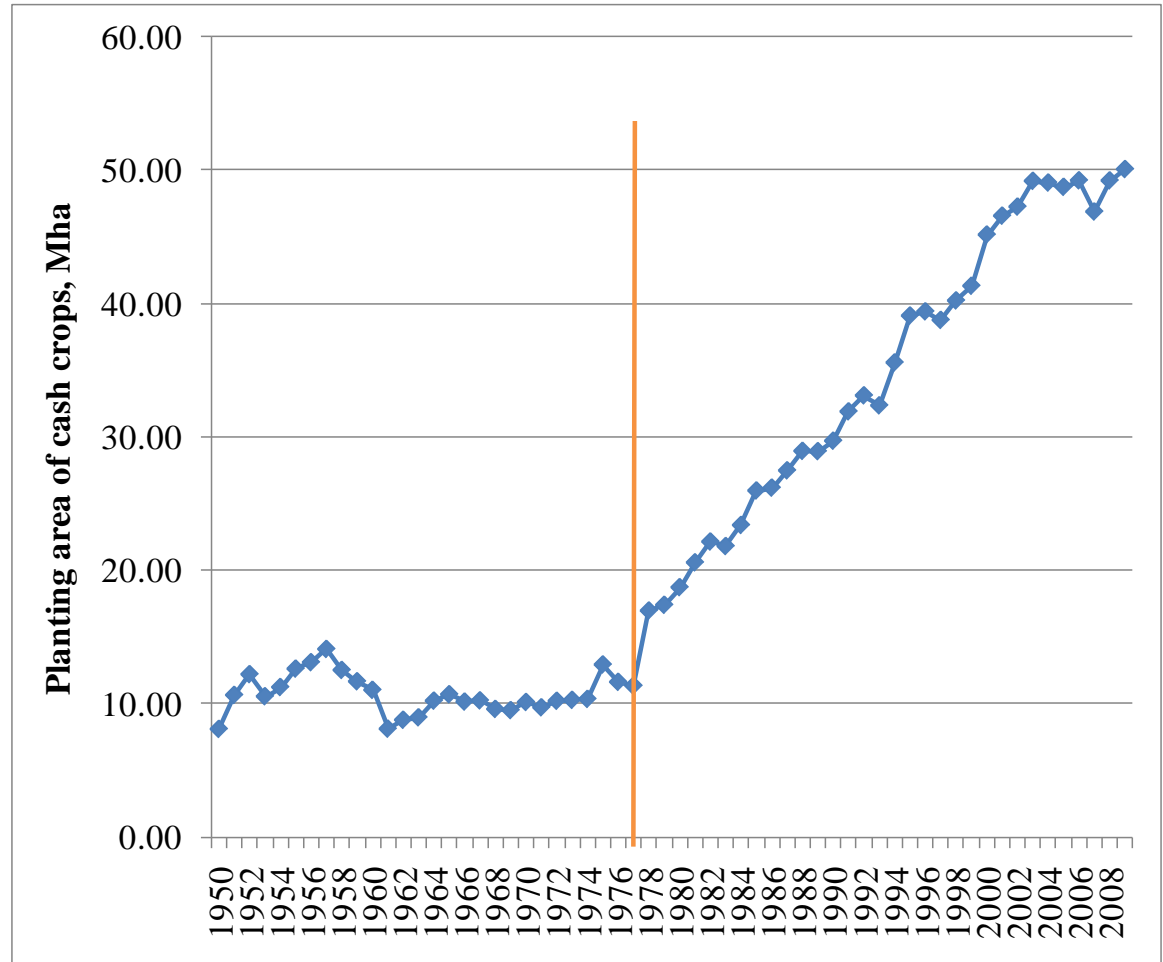
Chemical fertilizer consumption and distribution in China



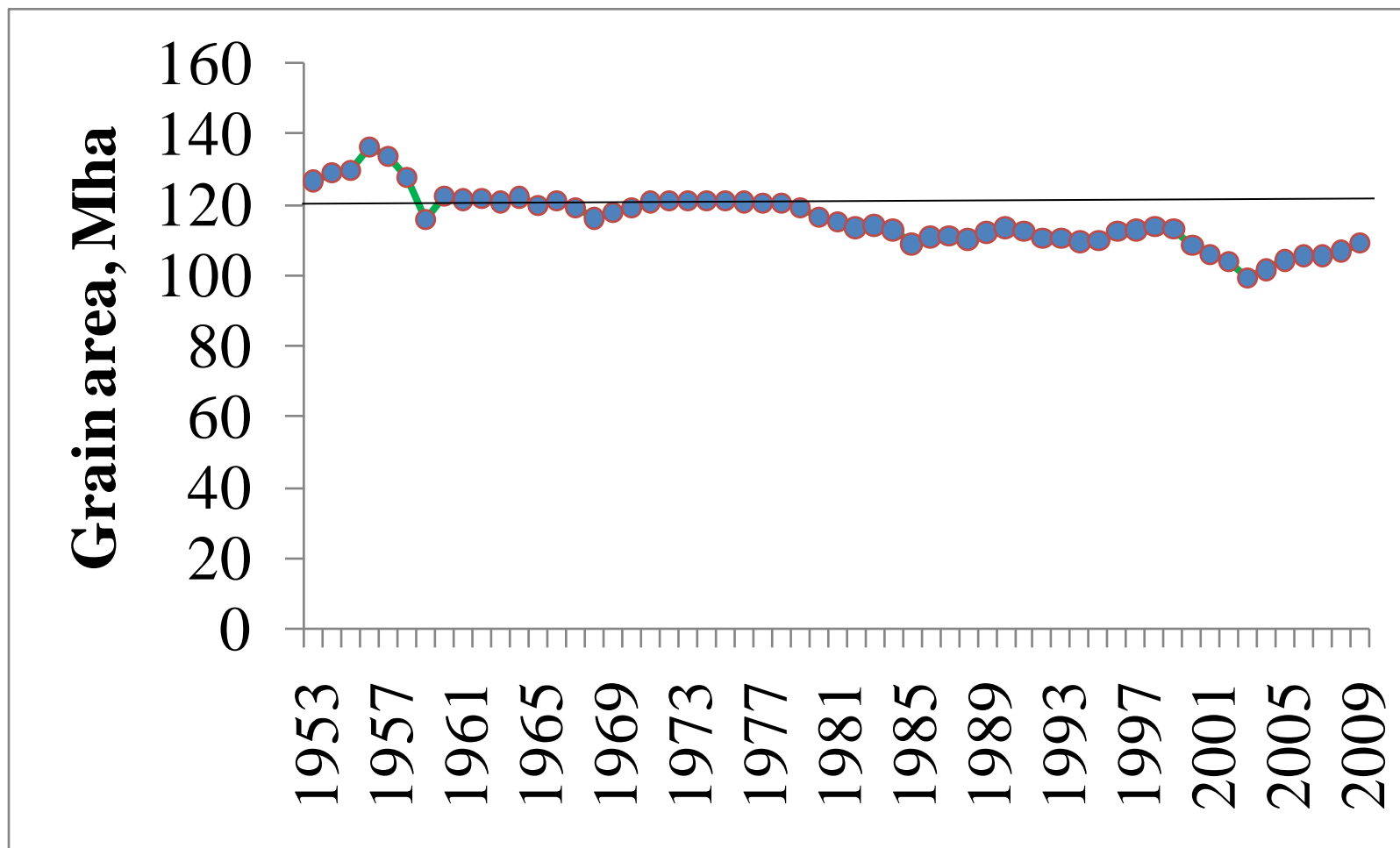
Area of cash crop increased rapidly since 1978

Area of cash crops including cotton, sugar crops, oil crops vegetables and fruits increased rapidly since 1978. Before 1978, the percentage of cash crops was 5-8% of total crop area, but increased to more than 30% now.

Changes of cash crop area since 1950

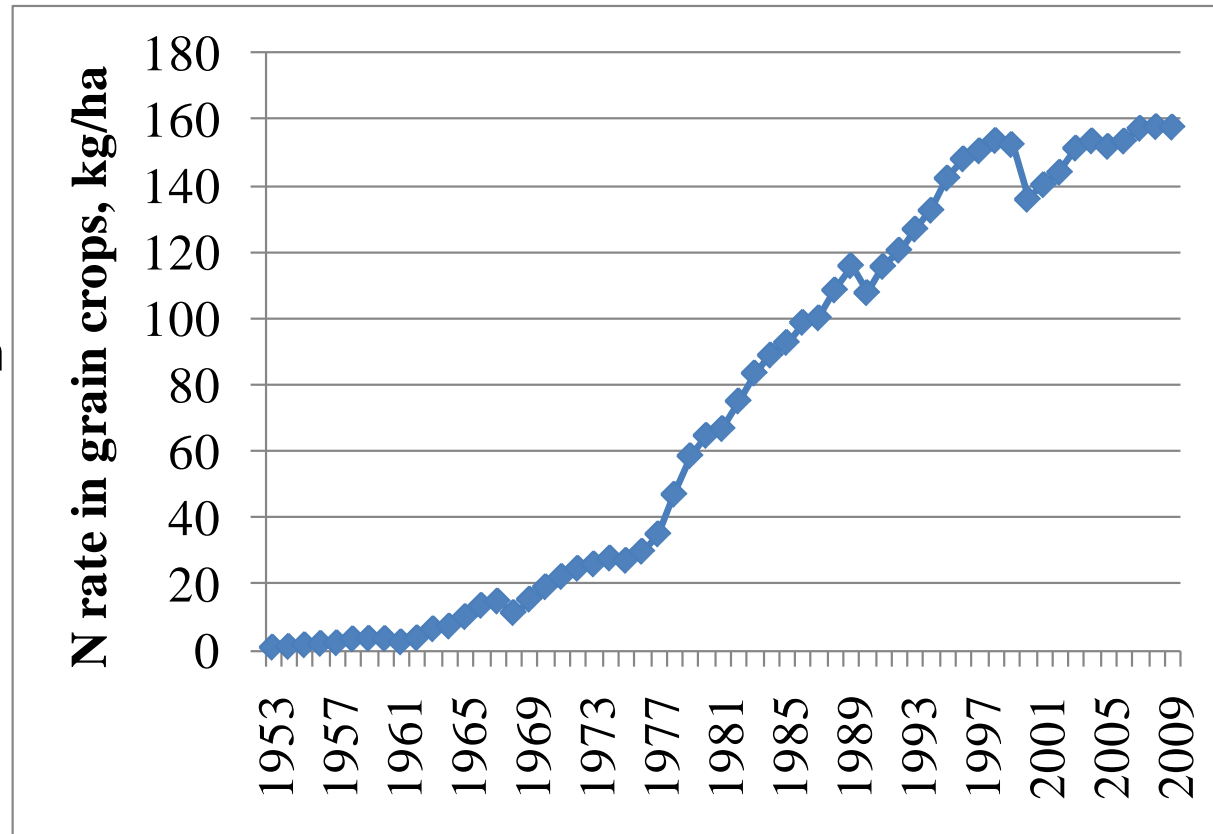


Changes of planting area of grain crops in China



Fertilizer N rate in grain crops

- According to the changes of crop area, assuming fertilizer used in grain crops was 90% before 1978, 80% from 1979 to 1989, 70% from 1990 to 1999, 60% since 2000.
- The mean calculated N applied in grain crops increased and in 2009 the rate was 158kg/ha of crop area.

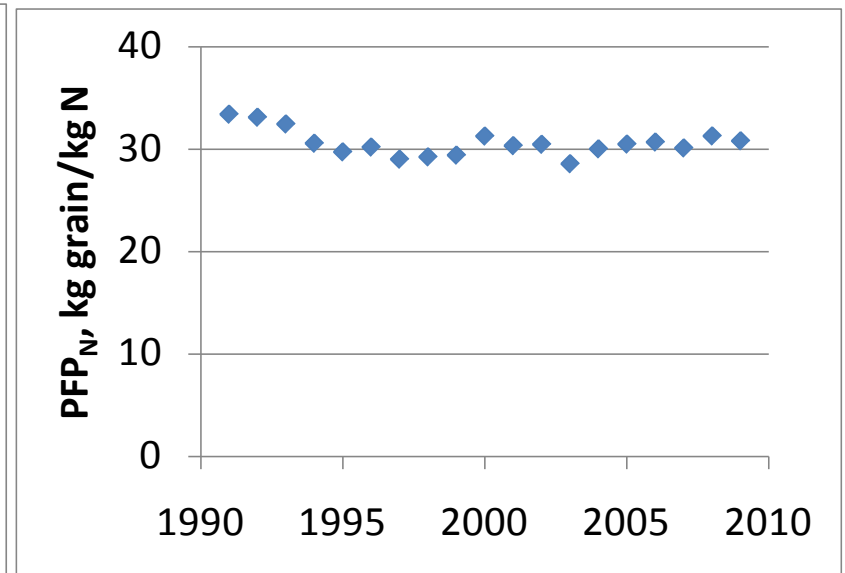
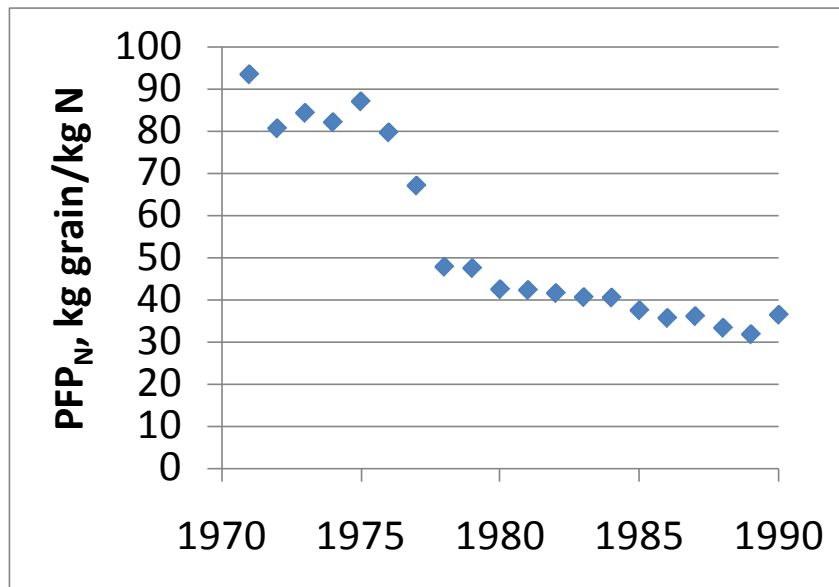
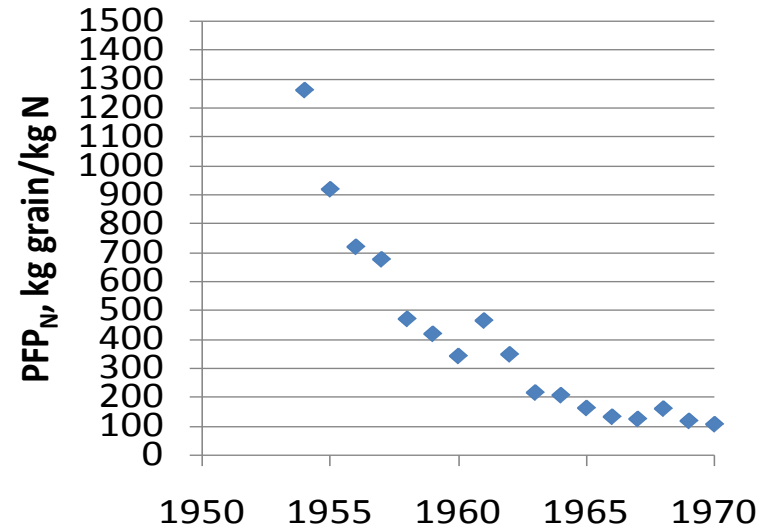
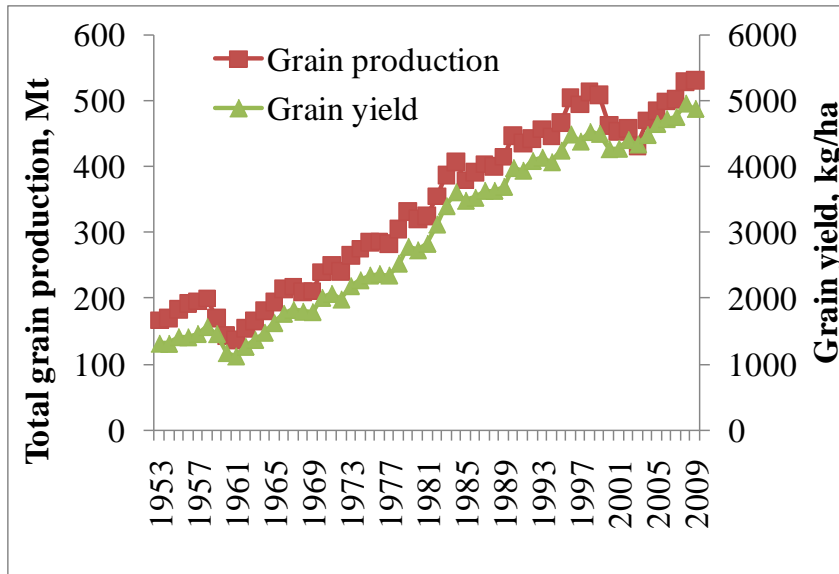


Source: China Agriculture Year Book

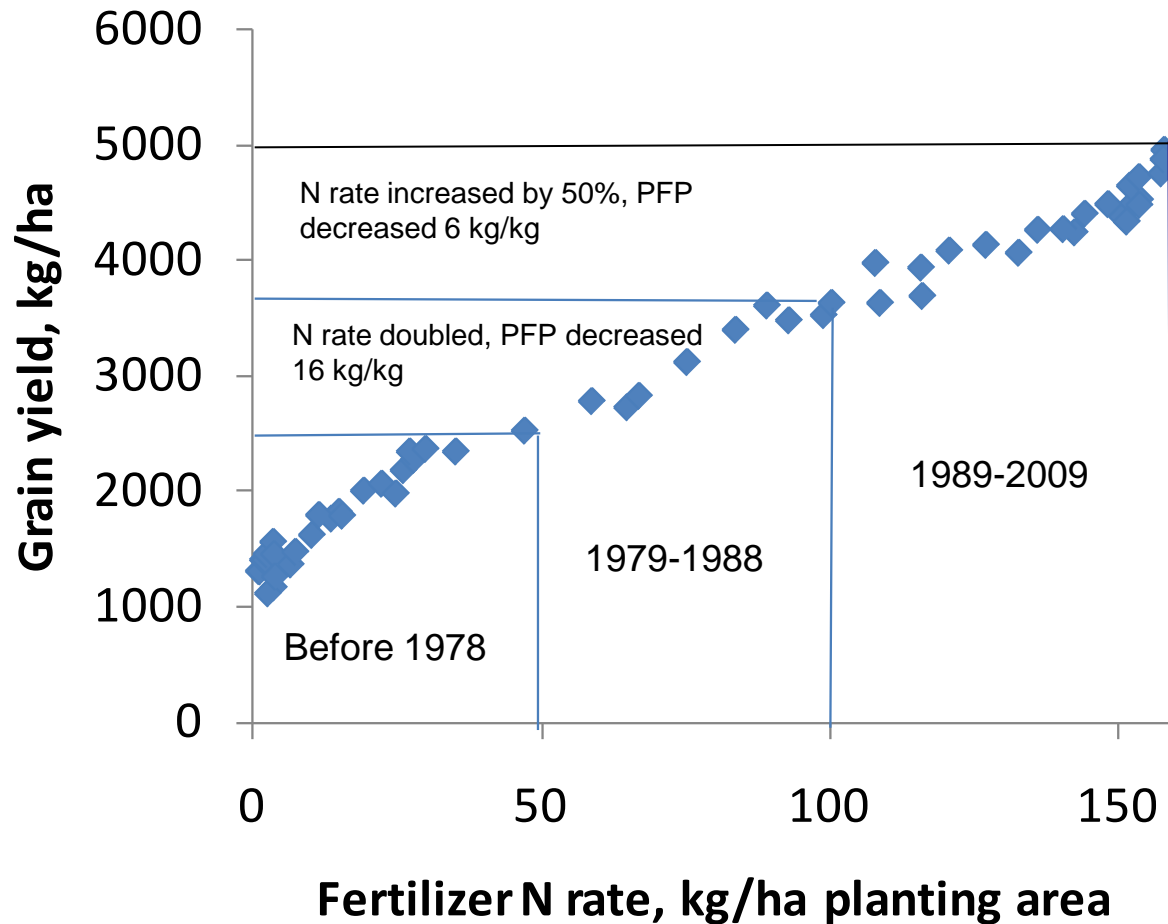
N use efficiency in grain crops



Changes of partial factor productivity of fertilizer N since 1950



The relationship between average cereal yields and average fertilizer-N use



Levels of cereal production, N fertilizer use on cereals, and cereal N use efficiency by world regions

Country	Cereal yield, t/ha	N rate, kg/ha	PFP _N , kg/kg
¹ China	4.9	158	31
² North Am	5.1	112	45
² NE Asia	6.1	89	71
² W Europe	5.5	113	59
² E Europe, C Asia	2.1	25	90
² Ocean	1.9	48	46
² Africa	1.1	9	123
² W Asia NE Africa	2.3	68	34
² South Asia	2.4	58	44
² SE Asia	3.2	65	53
² East Asia	4.8	155	32
² Latin Am	2.9	55	55
² World	3.1	70	44

¹Data of China was calculated based on China Agriculture Year Book.

²Dobermann, 2006 (invited paper)

Changes of agronomic efficiency of N (AE_N) in main grain crops in China

Crops	1958-1962 ¹		1981-1983 ¹		2002-2007 ²	
	N rate kg/ha	AE_N kg grain/kg	N rate kg/ha	AE_N kg grain/kg	N rate kg/ha	AE_N kg grain/kg
Rice	45-60	15-20	126	9.1	188	11.5
Wheat	45-60	10-15	117	10.0	193	10.5
Maize	45-60	20-30	124	13.4	224	9.6

¹ Lin and Li, 1989

² IPNI China program unpublished data

Changes of yield response to N fertilizer (kg/ha)

Crops	1958-1962 ¹	1981-1983 ¹	2002-2007 ²
Rice	675-1200	1140	2369
Wheat	450-900	1170	1911
Maize	900-1800	1665	2092

¹ Lin and Li, 1989

² IPNI China program unpublished data

N recovery efficiency in main grain crops (2002-2007)

Crops	Trial No.	Response kg/ha	AE_N kg grain/kg N	RE_N %
Rice	58	2369	11.5	27.2
Wheat	64	1911	10.5	43.8
Maize	70	2092	9.6	32.4

Sources: IPNI China program unpublished data

N use efficiency in different regions: AE=11-24kg/kgN, RE=0.31-0.68

Region/crop	N rate kg/ha	RE _{15N}	RE _N	PE _N kg/kg	AE _N	PFP _N
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 ¹⁵N isotope dilution method. All other N use efficiency terms – difference method, as described in Table 1.

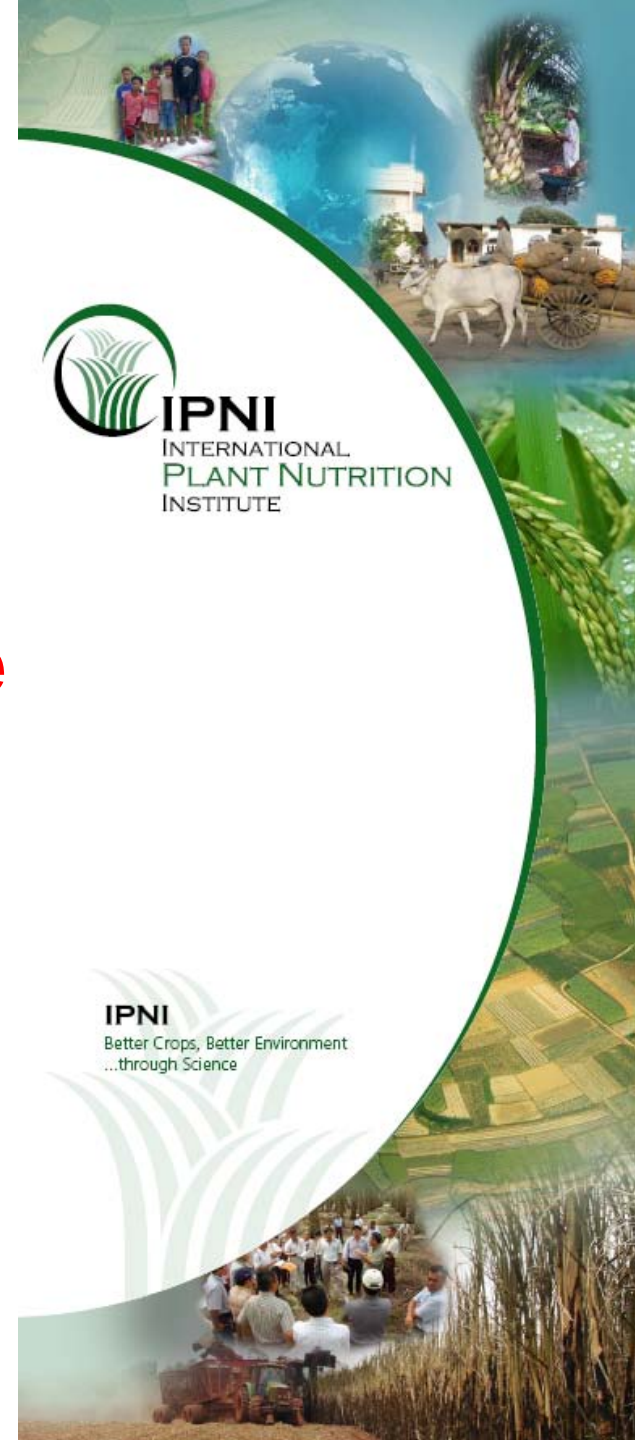
Dobermann, 2007

- 1. Agronomic efficiency (AE) of grain crops in China is about 10kg grain/kg N**
- 2. Agronomic efficiency of N (AE-N) in China is about half of the world average;**
- 3. Crop recovery efficiency (RE) of the first crop in China is about 15-20 lower than world average;**
- 4. The low N efficiency in China is due to high N rate for high yield production, and improper use of fertilizers;**
- 5. It is important to further improve fertilizer use efficiency in China for sustained increase of crop production;**
- 6. 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.**

Strategy to improve N use efficiency in China



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Better Crops, Better Environment
...through Science



Technology development to improve nutrient use efficiency

- **Soil testing and fertilizer recommendation**
- **Use of organic resources**
- **Best management practices (BMPs)**
- **Slow/controlled release fertilizers**
- **Fertigation**

Develop different nutrient application strategies based on soil fertility

- **If N deficient or in low organic matter, then fertilization to increase yield and build up soil fertility**
- **If adequate, then fertilization to maintain soil fertility**
- **If over fertilized and accumulated nitrate in soil profile, reduced fertilizer N and deplete nutrients in soil.**

Fertile, productive, healthy crop land will be developed.

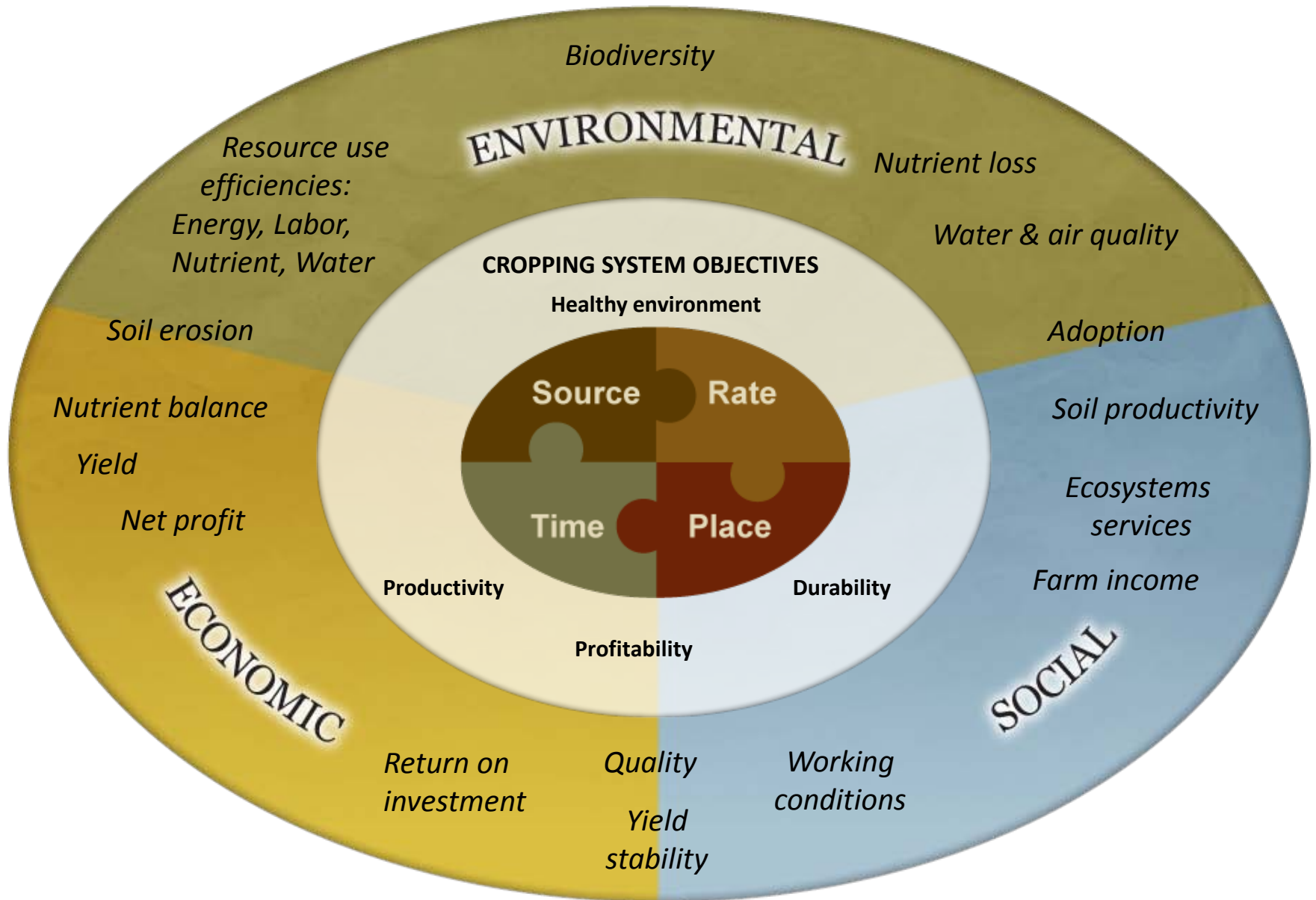
Made full use of organic sources of N

Estimated organic fertilizer sources in China

Sources	Amount (Mt)	N (Mt)
Animal waste	2909.65	13.95
Straw	810.90	7.55
Cake manure	26.27	1.56
Green manure	100.00	0.50
Total	3846.83	23.56

(Li et al., unpublished)

4R Nutrient Stewardship



Thanks and welcome comments



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