



Economic development, paddy field loss and rice output in China

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Outline of Presentation

- **Background and research objectives**
- **Data and Methodology**
- **Hypothesis**
- **Model and results**
- **Discussion and conclusions**

1. Background and research objective

Fig.1 Grain and rice output in China: 1978-2004

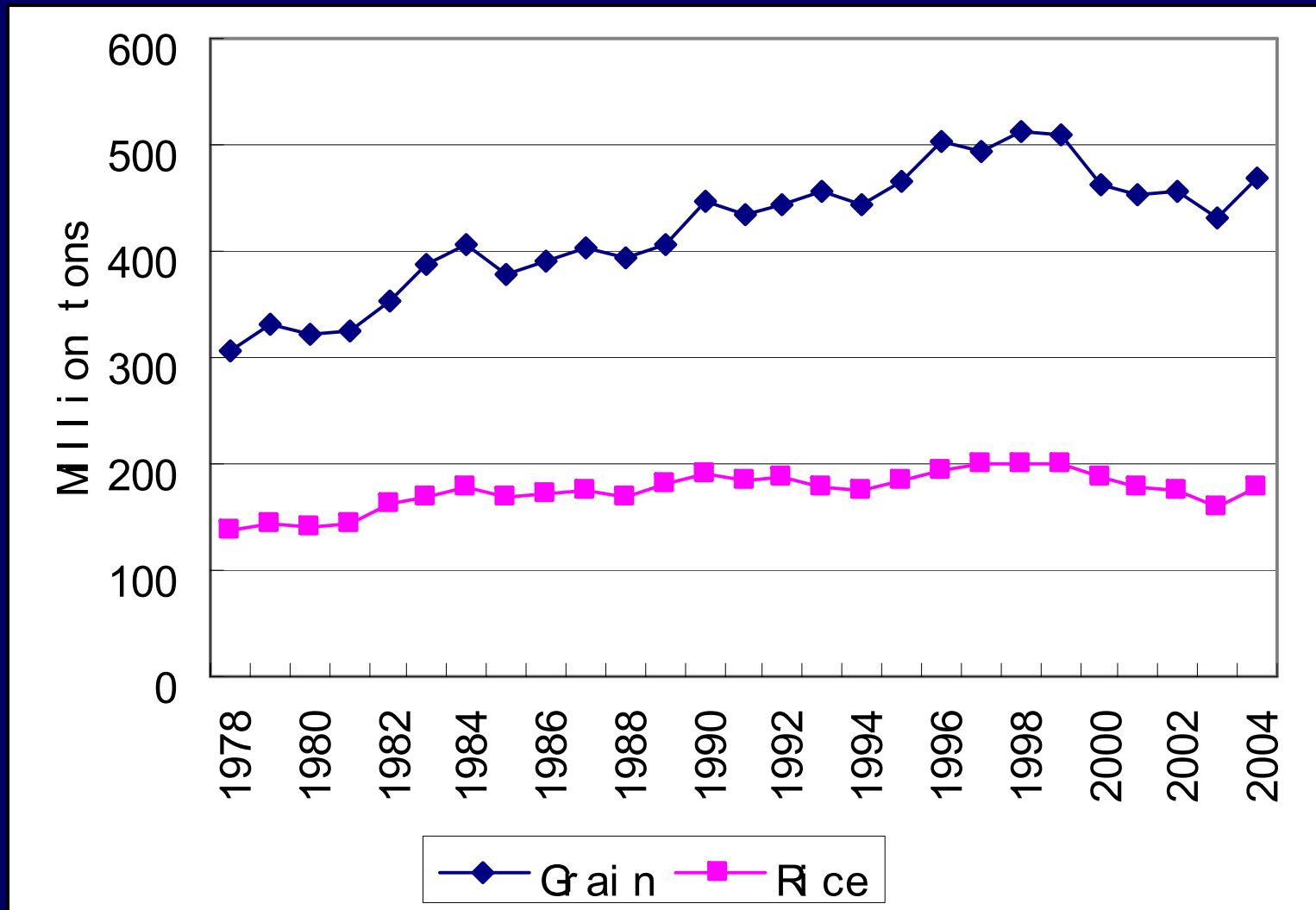


Fig.2 GDP per capita in China: 1978-2004

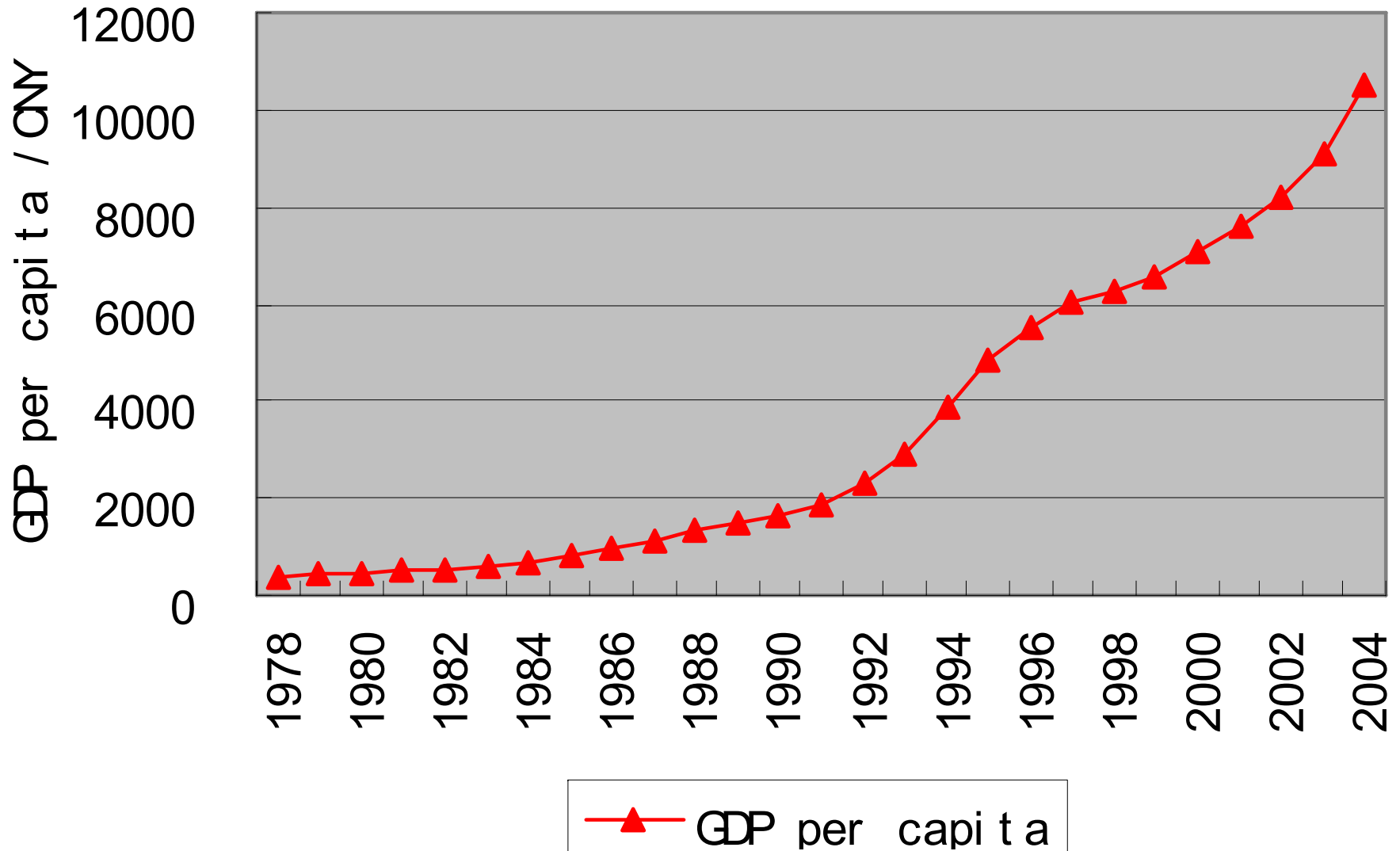


Fig.3 Urbanization in China: 1978-2004

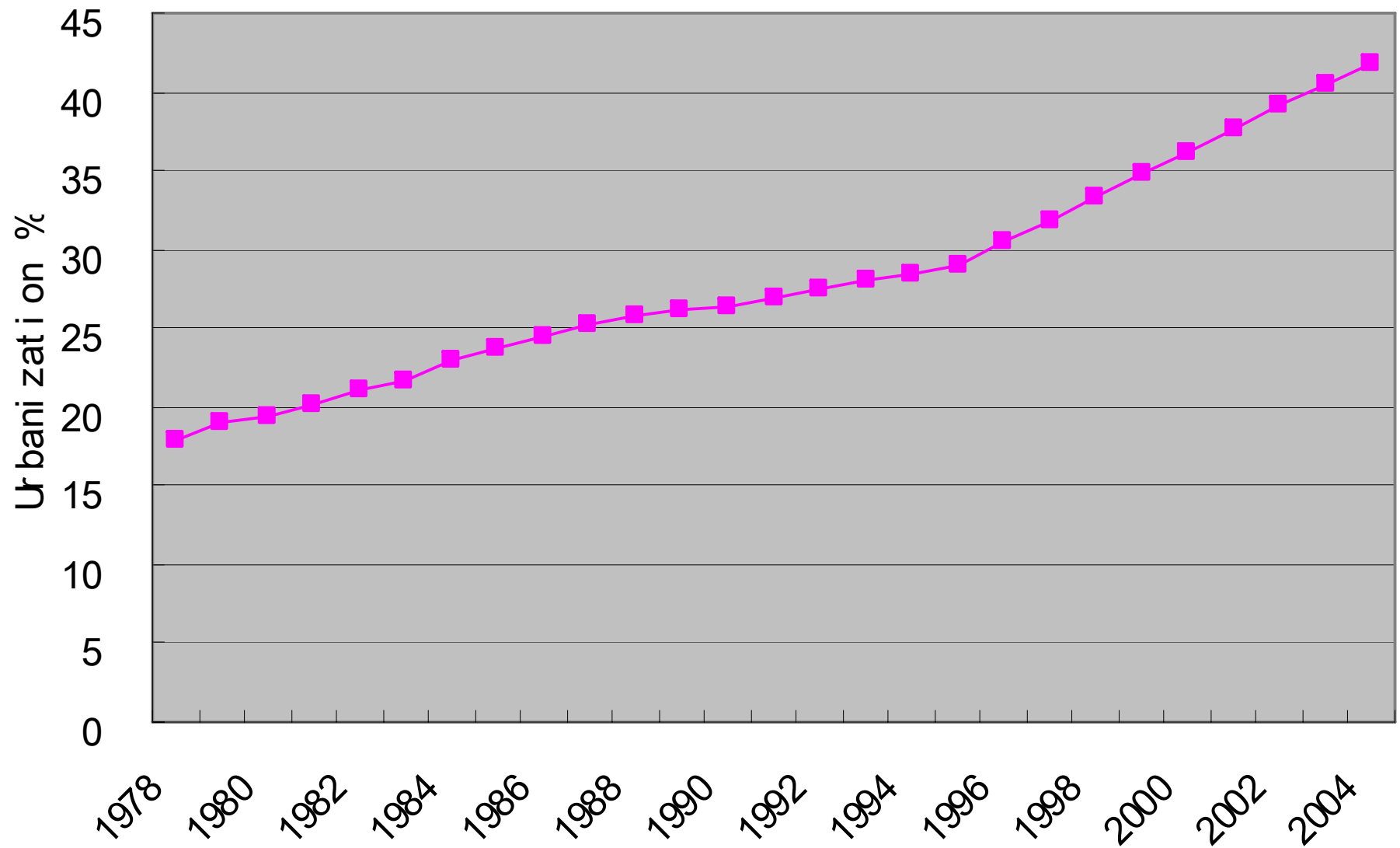


Fig.4 Rice sown area and rice output in China: 1978-2004

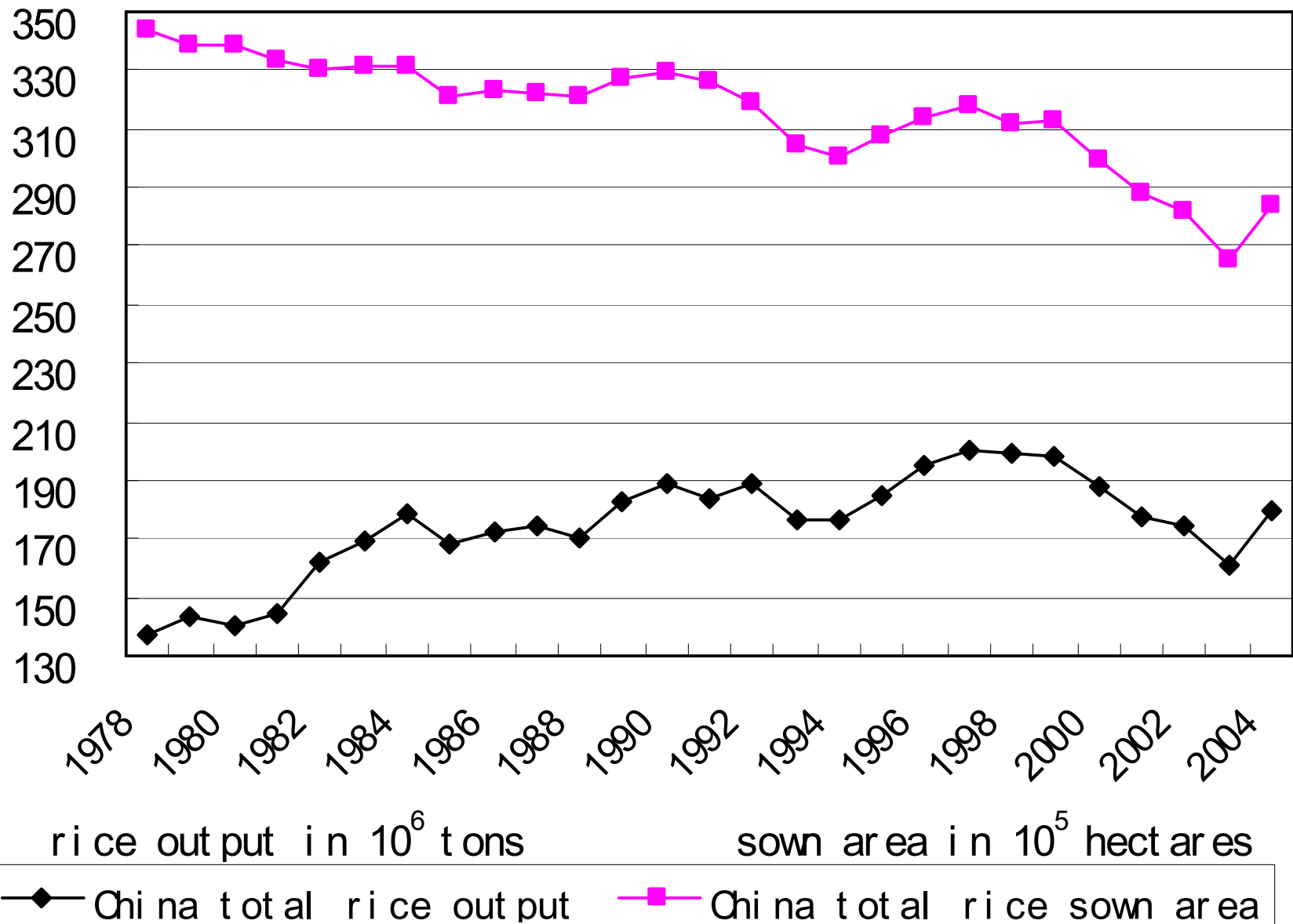
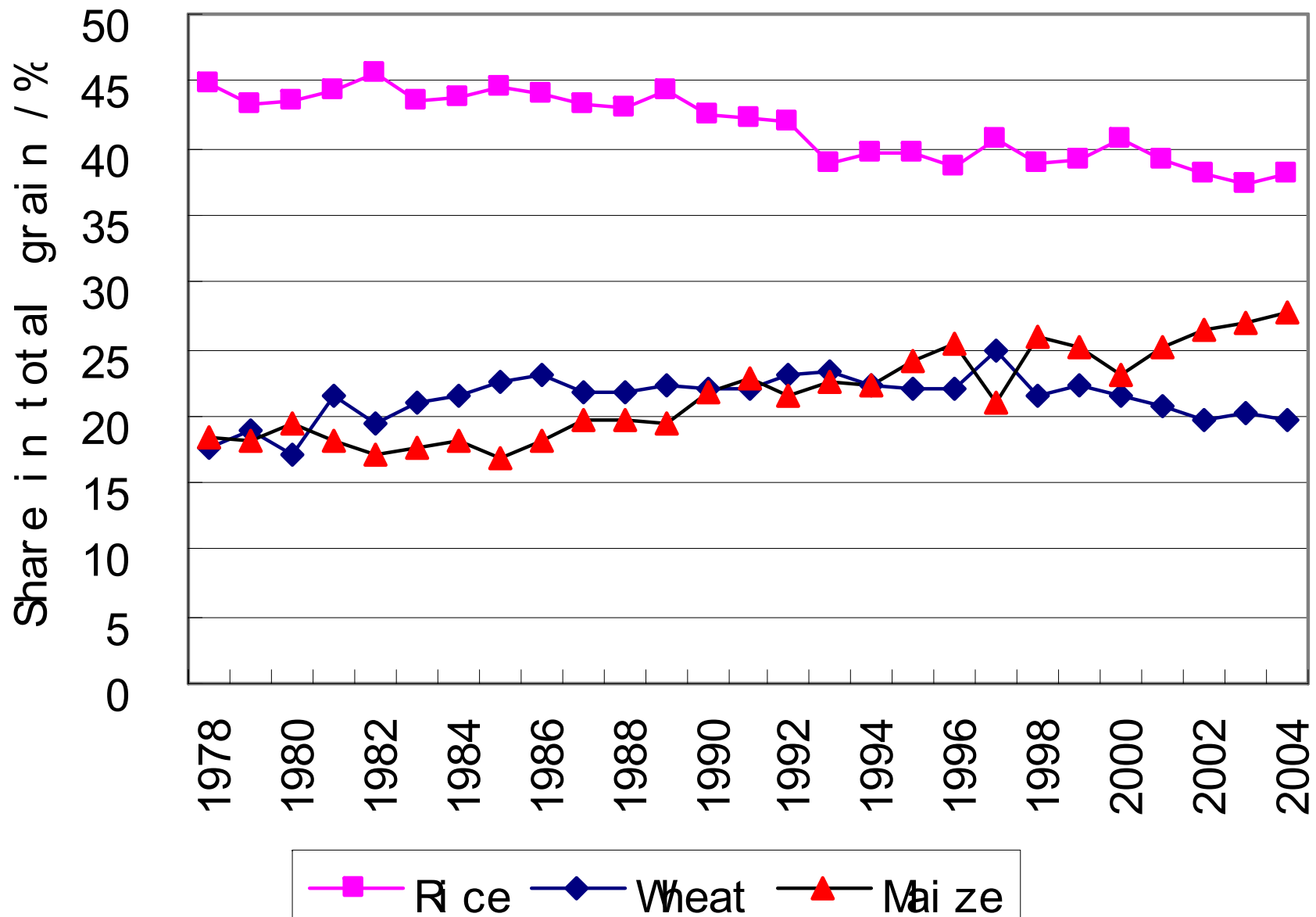


Fig.5 Share of rice, wheat and maize in total grain output in China: 1978-2004

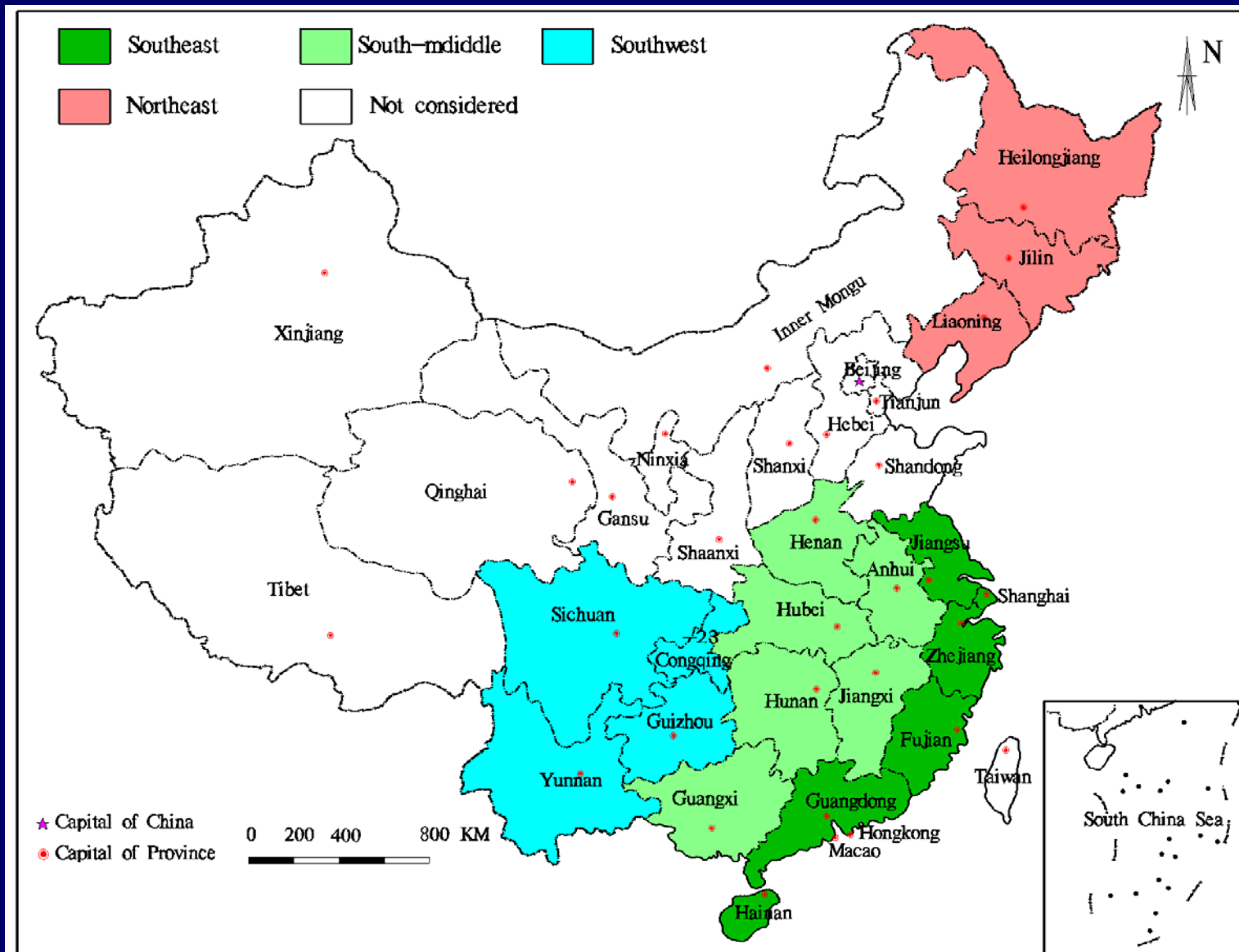


- Economic development
- Urbanization
- Paddy fields loss
- Rice price and costs
- Rice sown area change
- **Rice output change**

Aiming at: rice output and its influencing factors.

2. Data and Methodology

Fig. 6 Study area and major rice planting regions



Study area:

Major rice planting provinces (19) : 6 provinces in southeast region (SE), 6 in South-middle (SM), 4 in southwest (SW), 3 in northeast (NE)

- **Time periods :**
 - 1978-2004 for total China
 - 1985-2004 and 1996-2004 for every province unit (paddy fields only available 1996-2004)
- **variation:**
 - GDP, urbanization, farmer income, paddy fields, rice price and costs, rice sown area, rice output, agricultural input etc.
- **Data analysis:**
 - First computed in province level
 - Imported to MapGIS
 - Grouped as southeast, south-middle, southwest and northeast.

Fig.6 Rice output and its share in total China rice output for every province in 1985

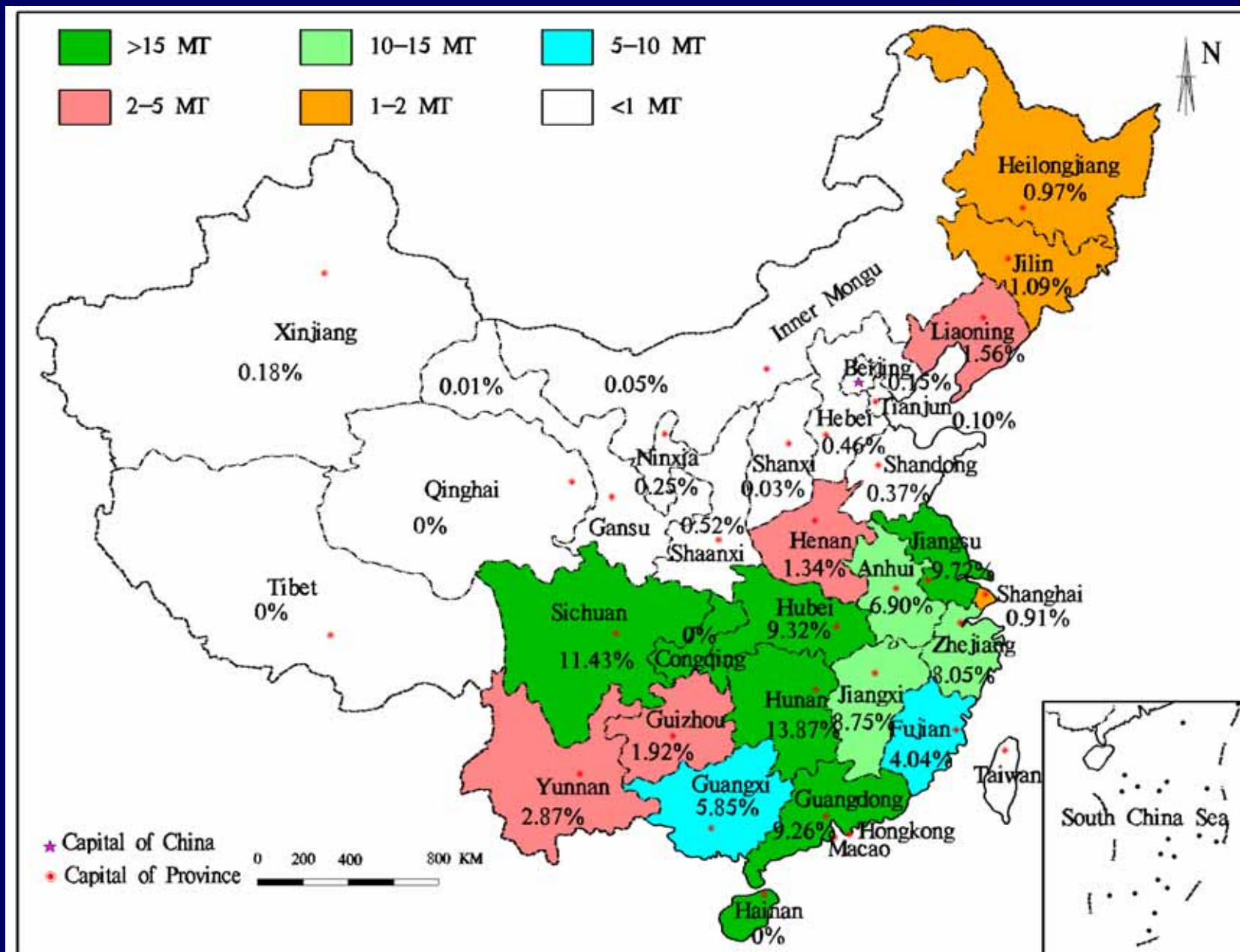
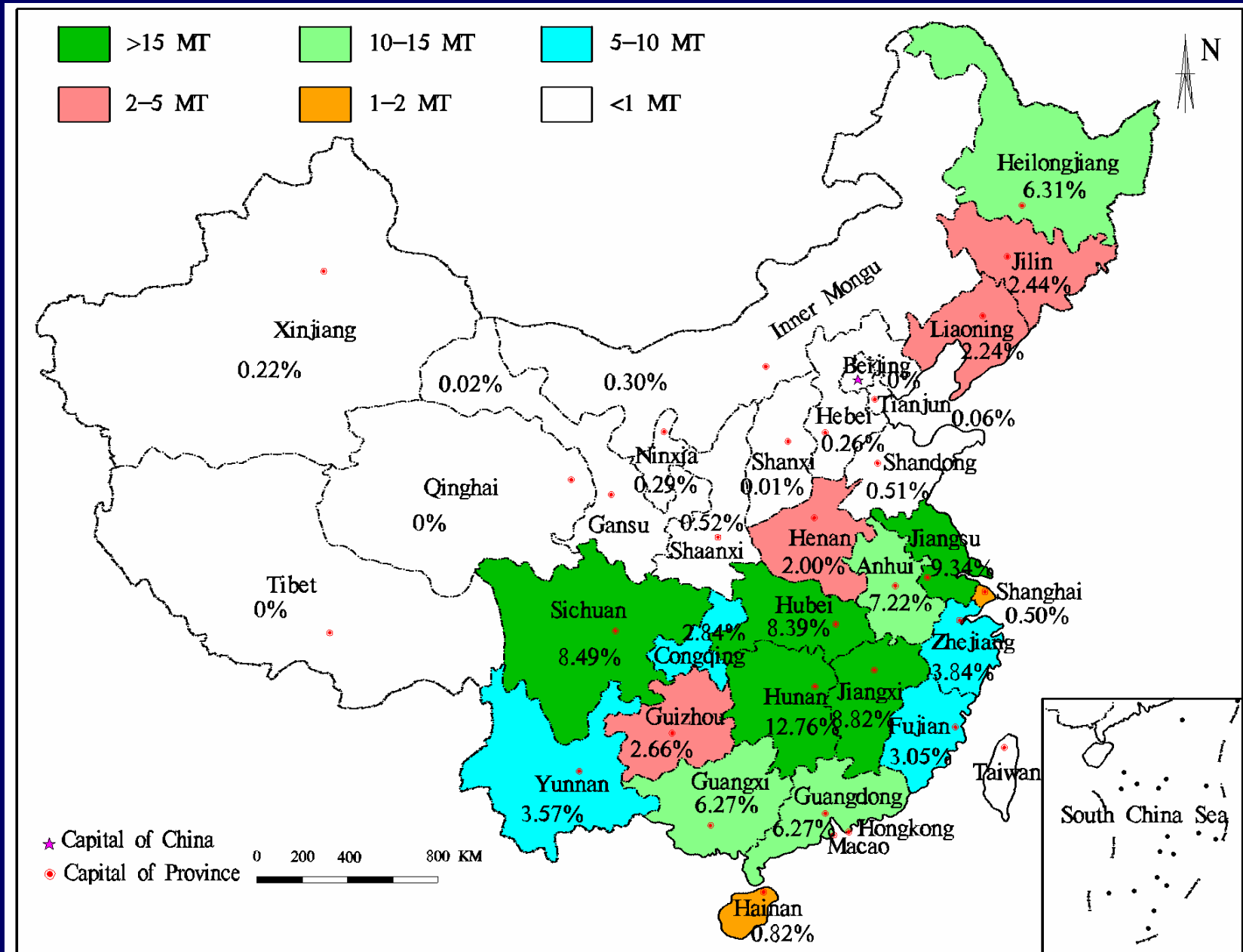


Fig.7 Rice output and its share in total China rice output for every province in 2004



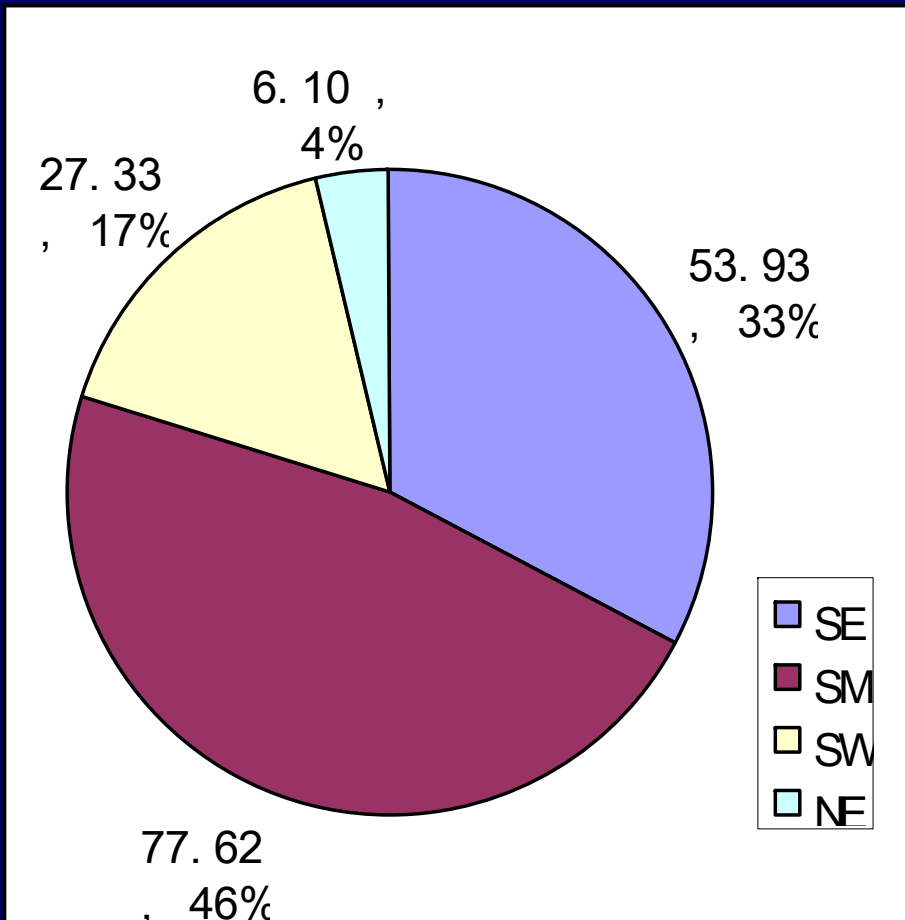


Fig.8 Rice output for differernt regions in 1985

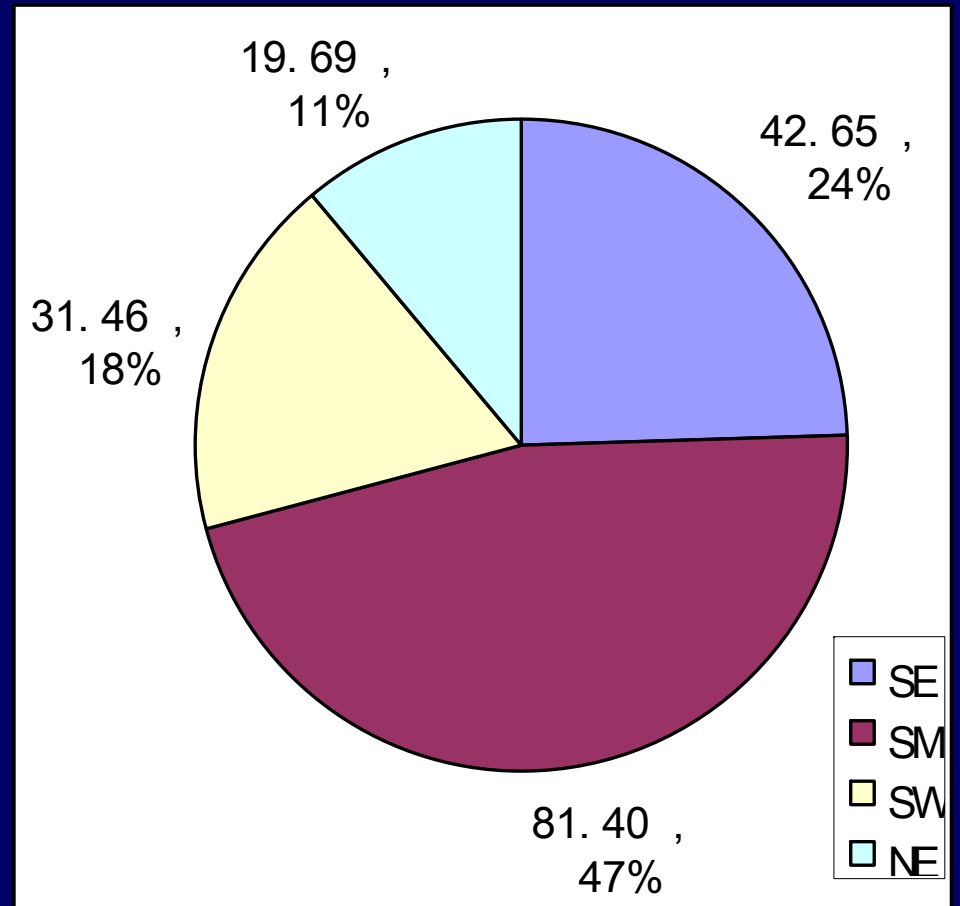
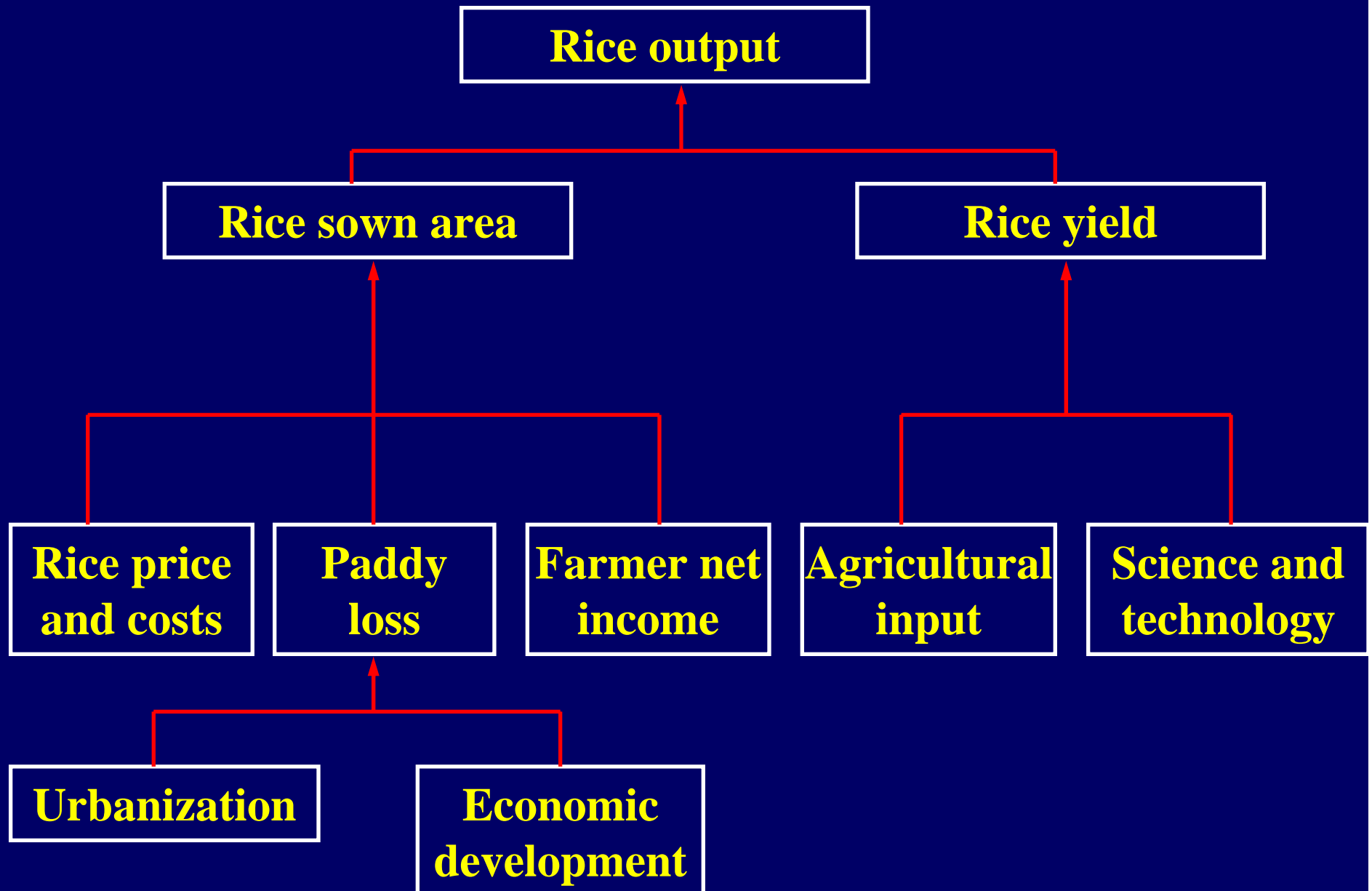


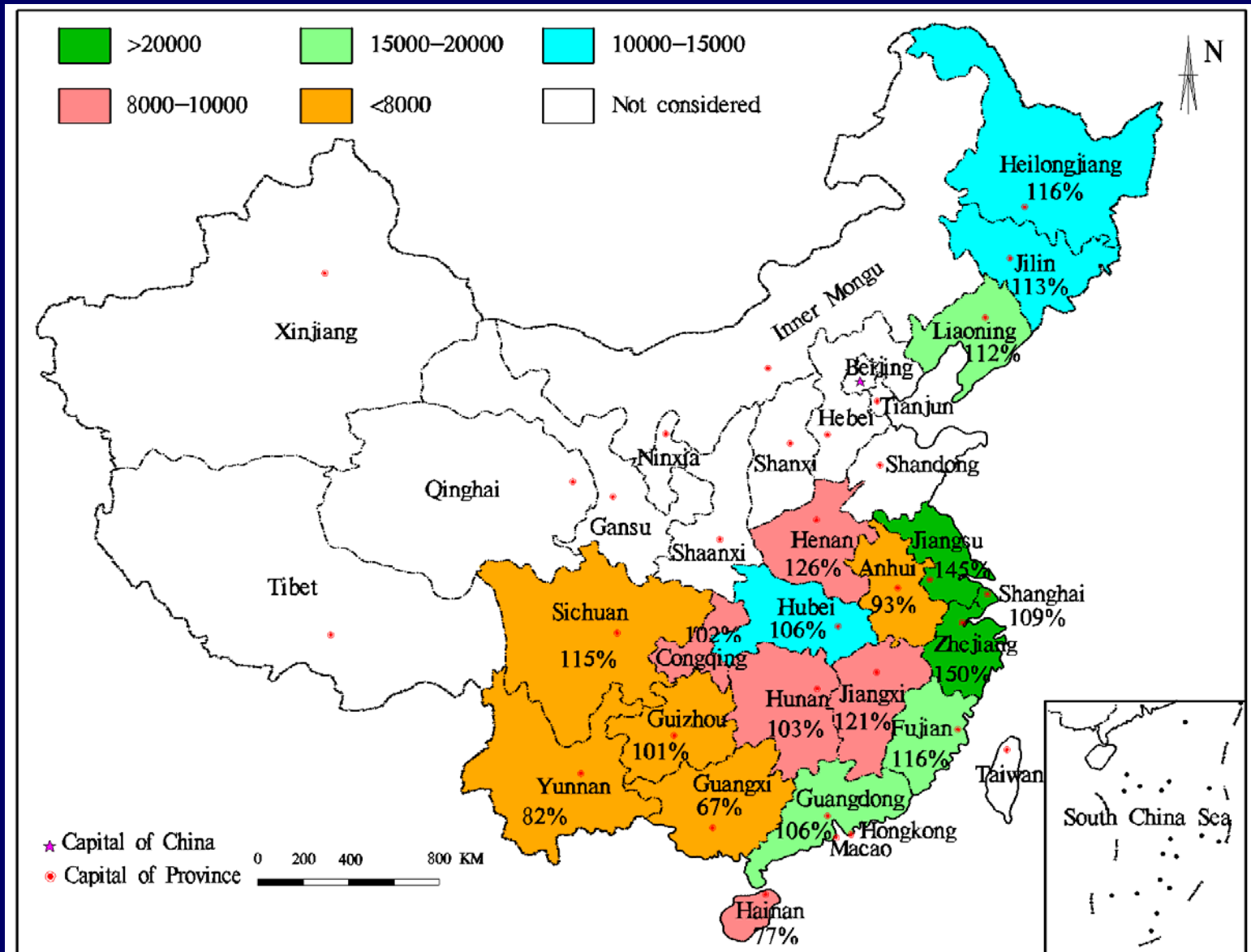
Fig.9 Rice output for differernt regions in 2004

3. Hypothesis



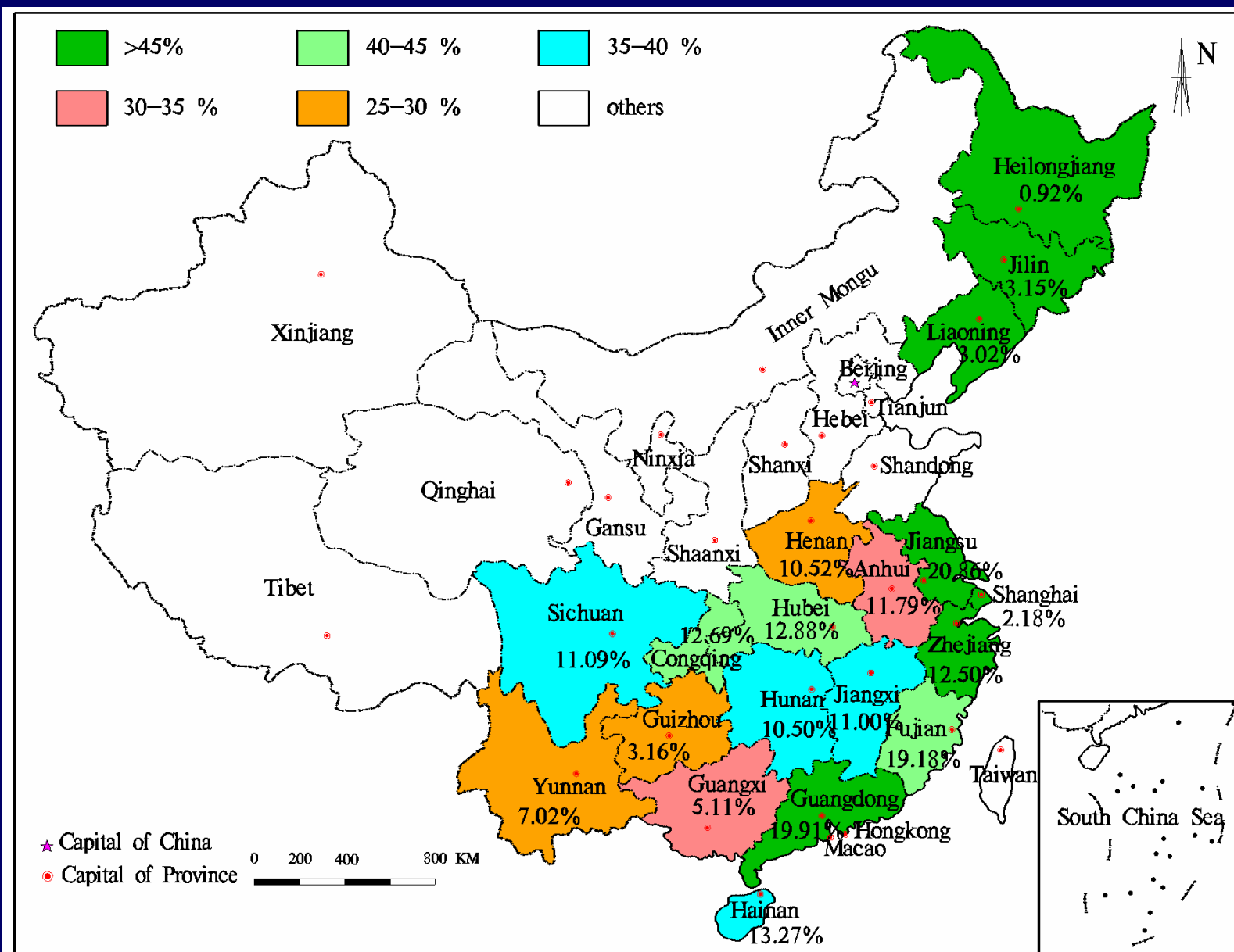
➤ Economic development

- Fig. GDP per capita for provinces in 2004 and its growth of 1996-2004



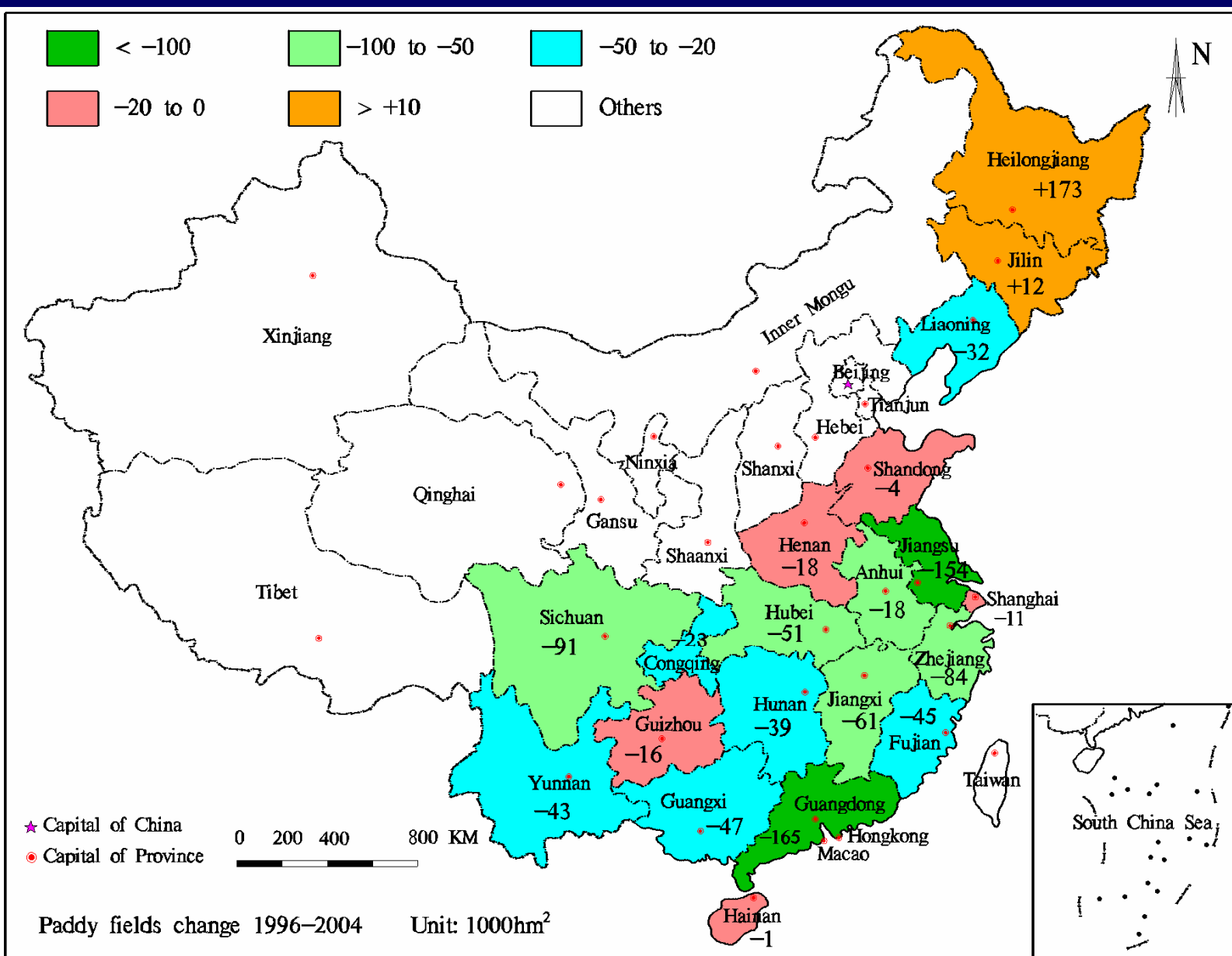
➤ Urbanization

Fig.10 Changes of urbanization for major rice planting provinces 1996-2004



➤ Paddy loss

Fig. 11 Paddy fields loss for provinces 1996-2004



➤ Improvement of science and technology

Fig. 12 Rice yield per sown area of China 1978-2004

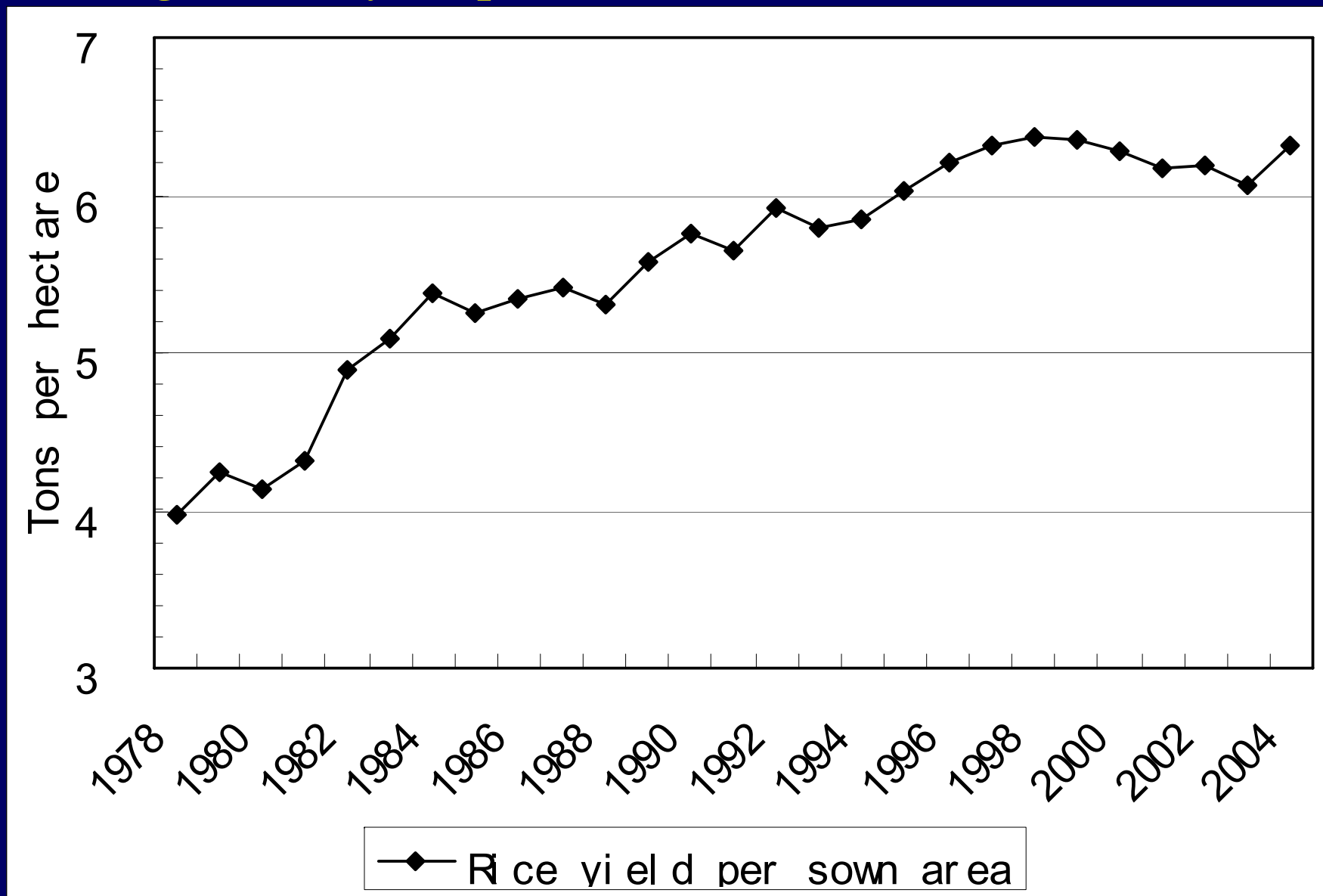
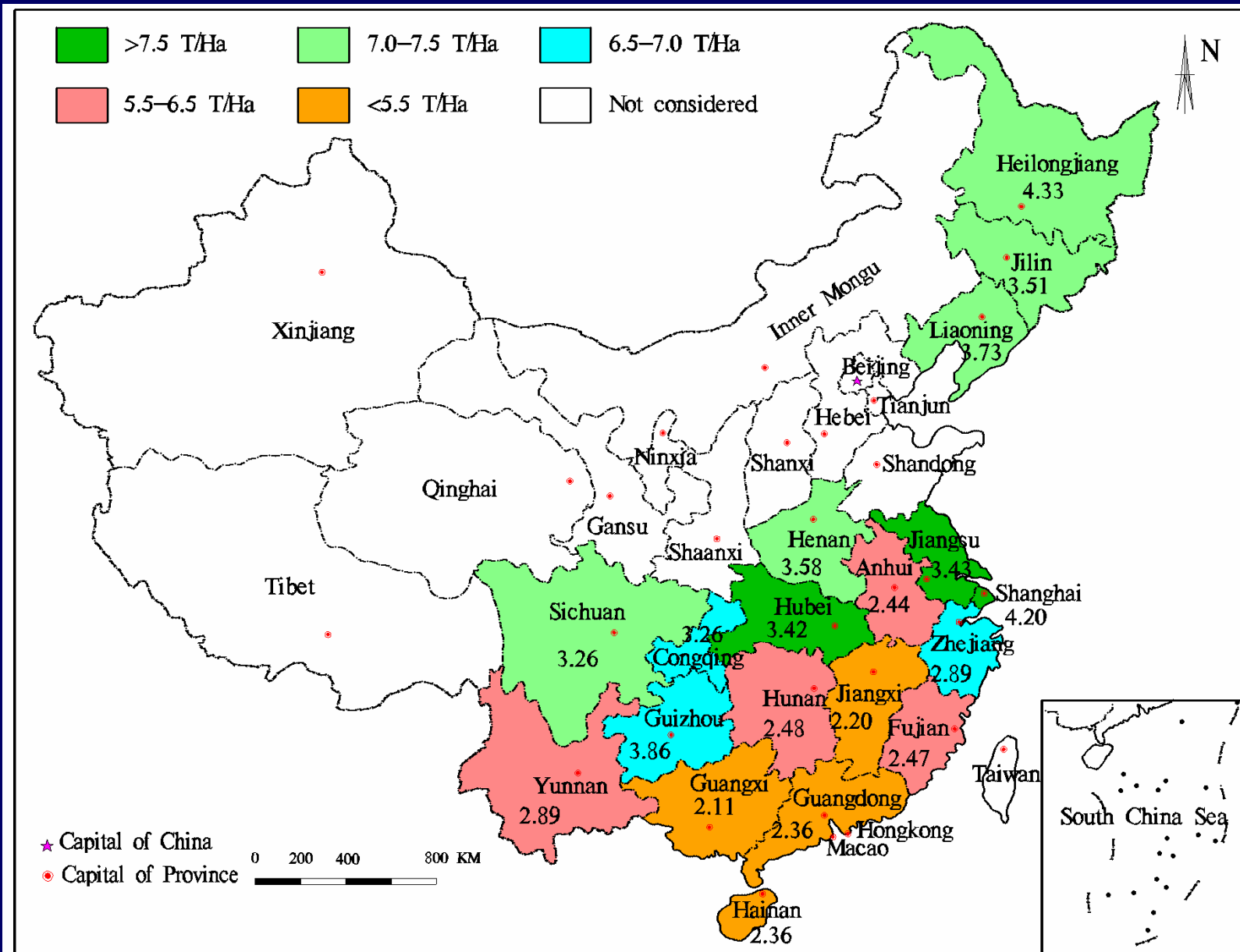


Fig. 13 Rice yield per sown area for provinces in 2004 and its changes of 1985-2004



4. Model and results

- **Rice output estimation model**

$$RO_{it} = RS_{it} * RY_{it}$$

- *RO*: rice output (tons)
- *RS*: rice sown area (in ha)
- *RY*: rice yield per rice sown area (in tons/ha)

Rice sown area panel date cross-section model:

$$RS_{it} = a_1 PF_{it} + a_2 RP_{it} + a_3 RC_{it} + a_4 FI_{it} + c$$

- **RS:** rice sown area (in 10^3 ha)
- **PF:** paddy fields land area (in 10^3 ha)
- **RP:** relative price of rice production (index of retail grain)
- **RC:** cost of rice production (index of agricultural cost)
- **FI:** farmer net income per capita (in CNY)

- **Paddy fields cross-section model:**

$$PF_{it} = \alpha_1 UPOP_{it} + \alpha_2 GDP_{it} + \beta$$

- *PF*: area of paddy fields (in 10³ha)
- *UPOP*: share of urban population
- *GDP*: amount of GDP (in 10⁸ CNY).

- **Rice yield cross-section model:**

$$RY_{it} = b_1 AI_{it} + b_2 IST_{it} + k$$

- *RY*: rice yield per unit rice sown area (in tons/ha),
- *AI*: agricultural input, represented by volume of pure chemical fertilizer (in 10⁴ tons)
- *IST*: improvement of science and technology to rice yield, represented by the GDP value (in 10⁸ CNY)

Tab.1 Panel (balanced) data estimates of rice sown area change models: 1996-2004

Independent variables	Total		Southeast		South-middle		Southwest		Northeast	
	Coefficient	<i>t</i> Statistic	Coefficient	<i>t</i> Statistic	Coefficient	<i>t</i> Statistic	Coefficient	<i>t</i> Statistic	Coefficient	<i>t</i> Statistic
PF	0.8534	13.94***	0.5816	7.83***	0.9164	5.60***	1.2582	12.11***	2.5692	23.28***
RP	26.4707	4.77***	23.4157	3.03***	41.7699	2.77***	18.8943	3.36***	-1.4374	-0.43
RC	-38.5944	-4.46***	-32.1411	-2.55***	-52.9045	-1.93**	-31.1523	-3.33***	3.1776	0.60
FI	-0.0835	-1.69*	-0.0351	-0.48	-0.1173	-0.37	-0.1775	-1.13	0.0372	0.69
c	1966.73	2.72***	1884.13	1.73*	1963.13	0.87	1345.43	1.60	-1516.76	-3.43***
R^2	0.7258		0.7738		0.5877		0.9164		0.9611	
Adjusted R^2	0.7184		0.7512		0.5541		0.9012		0.9541	
<i>F</i> statistic	97.94***		34.21***		17.46***		60.29***		136.06***	
N^b	153 (17×9)		45 (5×9)		54 (6×9)		27(3×9)		27 (3×9)	

Dependent variable : rice sown area

*** significance: 10%; ** significance: 5%; *** significance: 1%.**

Tab.2 Panel (balanced) data estimates of paddy fields change models (Fixed cross-section) : 1996-2004

Independent variables	Total		Southeast		South-middle		Southwest		Northeast	
	Coefficient	<i>t</i> Statistic	Coefficient	<i>t</i> Statistic	Coefficient	<i>t</i> Statistic	Coefficient	<i>t</i> Statistic	Coefficient	<i>t</i> Statistic
UPOP	-1.1951	-2.01***	0.3602	0.56	-2.6866	-3.97***	0.7222	1.44	-21.2127	-1.62
GDP	-0.0097	-5.14***	-0.0152	-8.02***	-0.0030	-1.07	-0.0275	-11.65***	0.0325	2.43***
c	1532.09	87.31***	1406.09	62.02***	2098.94	171.10***	1298.67	134.10***	1808.88	2.80***
R^2	0.9995		0.9997		0.9998		0.9999		0.9717	
Adjusted R^2	0.9994		0.9997		0.9998		0.9999		0.9665	
<i>F</i> statistic	13901***		23838***		38298***		112657***		189***	
N^b	171 (19×9)		54 (6×9)		54 (6×9)		36(4×9)		27 (3×9)	

Dependent variable : paddy fields

*** significance: 1%.

Tab.3 Panel (unbalanced) data estimates of rice yield change models: 1985-2004

Independent variables	Coefficient	<i>t</i> Statistic
AI	4.6231	3.87***
IST	0.3257	10.85***
c	4167.8770	30.12***
R^2	0.4950	
Adjusted R^2	0.4666	
<i>F</i> statistic	17.45***	
N^b	584 (30×20)	

Dependent variable : rice yield

*** significance: 1%.

Tab. 4 The forecast results of rice output of China in 2020

Region	Paddy fields area		Rice sown area		Rice output I		Rice output II	
	1000 ha	%	1000 ha	%	Million tons	%	Million tons	%
China mainland	26055.3	100	21826.66	100	136.39	100	163.67	100
Sum of four regions	25891.93	99.37	21875	100.21	135.71	99.50	162.84	99.49
North-east region	2826.98	10.85	3620.74	16.59	24.11	17.68	28.95	17.68
Liaoning	638.66	2.45	686.75	3.15	5.09	3.73	6.11	3.73
Jilin	721.45	2.77	824.93	3.78	5.86	4.30	7.04	4.30
Heilongjiang	1466.87	5.63	2109.06	9.66	13.16	9.65	15.8	9.65
South-east region	7035.05	27.00	3811.26	17.46	24.67	18.09	29.6	18.09
Shanghai	286	1.10	65.74	0.30	0.52	0.38	0.63	0.38
Jiangsu	2691.54	10.33	1209.87	5.54	9.92	7.27	11.9	7.27
Zhejiang	1126.58	4.32	673.03	3.08	4.22	3.09	5.06	3.09
Fujian	786.71	3.02	688.56	3.15	3.64	2.67	4.37	2.67
Guangdong	1811.22	6.95	958.43	4.39	5.47	4.01	6.56	4.01
Hainan	333	1.28	215.63	0.99	0.9	0.66	1.08	0.66
South-middle region	11404.53	43.77	10067.25	46.12	57.78	42.36	69.32	42.35
Henan	617.16	2.37	512.16	2.35	3.32	2.43	3.98	2.43
Anhui	2413.09	9.26	1636.62	7.50	9.67	7.09	11.61	7.09
Jiangxi	1682.47	6.46	2526.21	11.57	13.2	9.68	15.83	9.67
Hubei	2299.68	8.83	670.33	3.07	4.95	3.63	5.94	3.63
Hunan	2397.47	9.20	2507.17	11.49	15.22	11.16	18.26	11.16
Guangxi	1994.66	7.66	2214.76	10.15	11.42	8.37	13.7	8.37
South-west region	4625.37	17.75	4375.63	20.05	29.15	21.37	34.97	21.37
Chongqing	692.84	2.66	625.89	2.87	4.16	3.05	4.99	3.05
Sichuan	1856.41	7.12	1696.24	7.77	13.02	9.55	15.62	9.54
Guizhou	791.25	3.04	669.81	3.07	4.11	3.01	4.93	3.01
Yunnan	1284.87	4.93	1383.69	6.34	7.86	5.76	9.43	5.76

Conclusions

- **Rice sown area decreased about 17.5% (1978-2004);**
- **Rice output increased about 30.8% (1978-2004);**
- **With economic developing and urbanizing, Paddy fields decreased (-3%, 1996-2004);**
- **Rice sown area diminished, as paddy fields losing, rice price decreasing and costs increasing;**
- **With science and technology improving and agricultural input increasing, rice yield went up;**
- **Rice sown area: southeast ↘, northeast ↗, south-middle ↘, southwest ↗;**

- Rice yield vary among provinces, increased quickly 1985-1995, slowly 1996-2004;
- Rice output: southeast ↘ , northeast ↗ , south-middle ↘ , southwest ↗ ;
- Rice sown area decrease remarkably in 2020, especially in southeast region;
- Rice planting area shifting from southeast to northeast;
- Rise of rice yield will mostly contribute to rice output growth in 2020.

Thank you very much for
your attention !

Your comments are very
much appreciated.