Research on Security of Land Ecological Environment

——A Case Study of the Southwest of Songnen Plain in China

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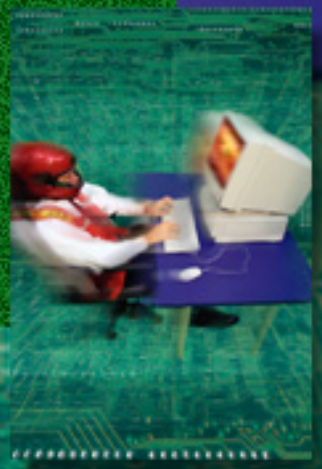


Outline

1. Introduction

1.1 Background of the problem

Concept:

(1) the health, integrity and sustainability of ecosystems;

(2) the ecosystems services contributed to human welfare.

Characteristics:

(1) globality;

(2) nonreversibility of ecological damage ;

(3) chronicity of ecological recovery.

- **The situation about the global ecology**

Global Ecology Concern ——Meadow Degeneration and Environment Pollution

Degeneration of Plantation

Dust storm

1.The sand dust was floating from the northwest of African continent to Atlantic

2.The sand dust was floating through the Red sea

Present questions of current research

(1) The foundation of special research on regional land ecological environmental security is weakness,

(2) The database and index system are lacked of the standardization and consistency,

(3) Research approach and technology of ecological security are needed to improve.

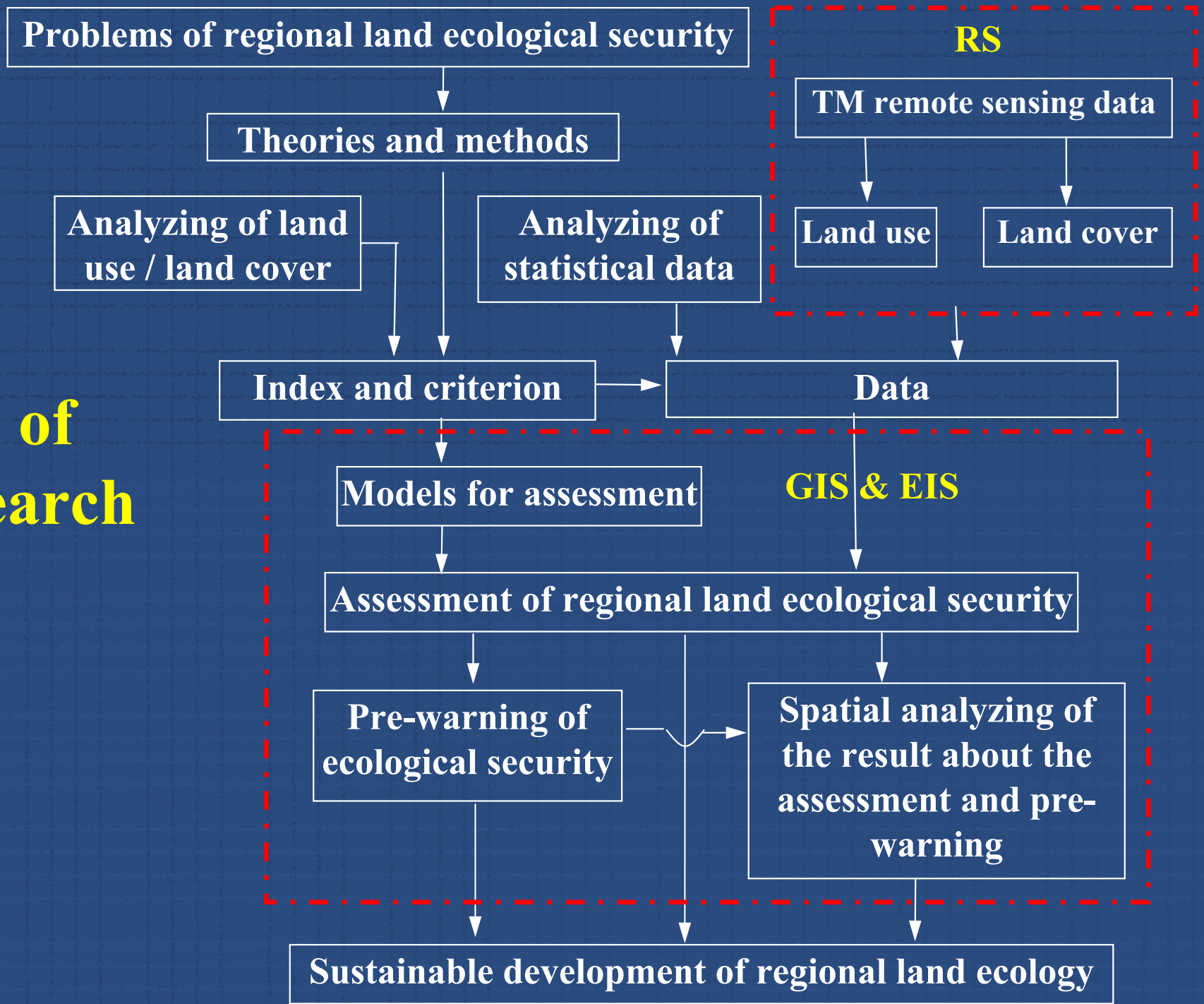
1.2 Research objectives

- Land use / land cover change of the study area
- Assessment of land ecological security
- Pre-warring of land ecological security

1.3 Research methodology

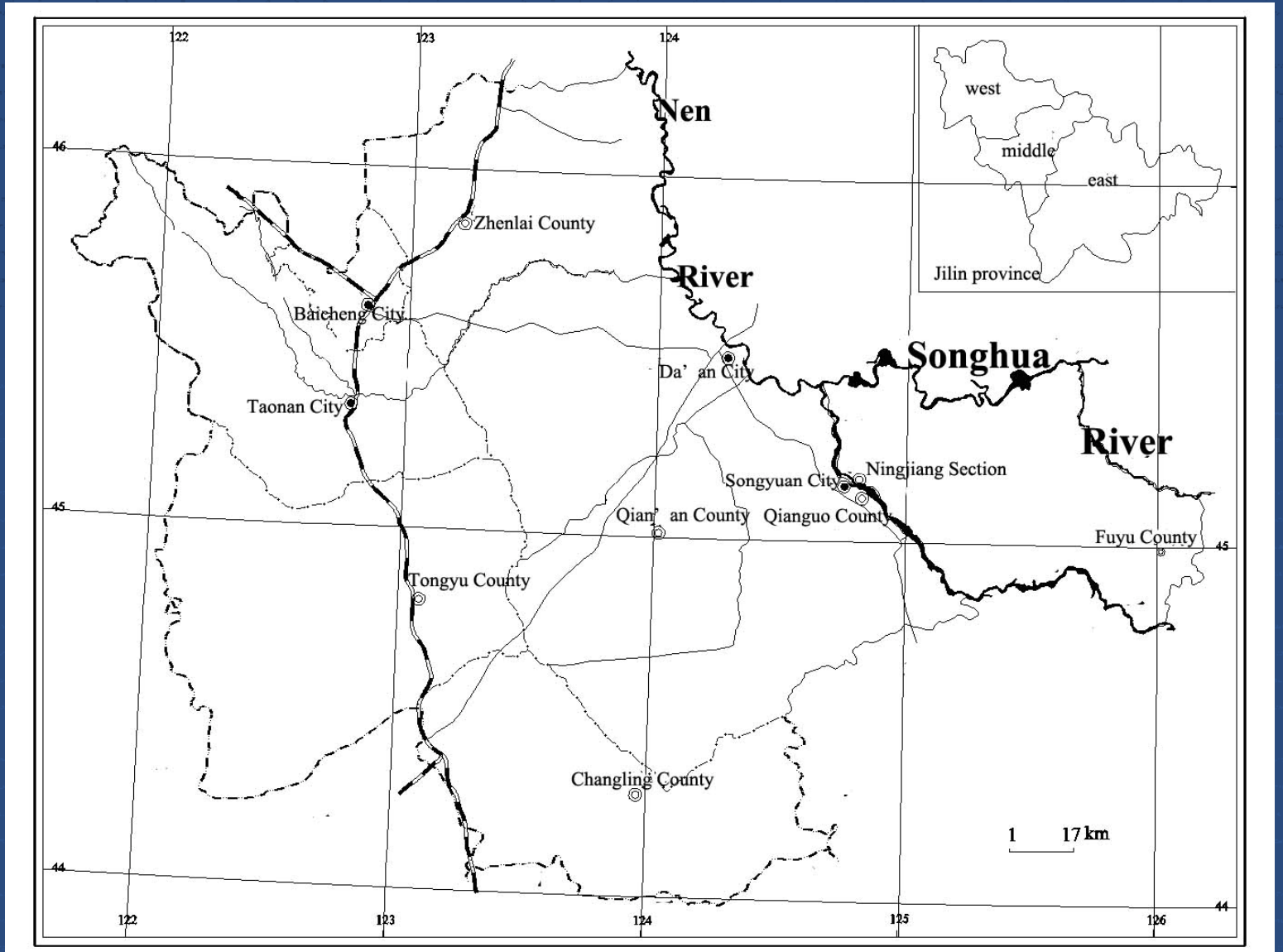
- RS—— Remote sensing data
- GIS—— Spatial analyses
- GPS——Orientation of research area
- EIS—— Mathematic models for assessment and pre-warning

Process of the research



2. Research on land ecological security

2.1 Introduction of the study area



Ecological situation of the study area

Meadow degradation

Land salinization

Lake & reservoir wadi

Soil desertification

Field work

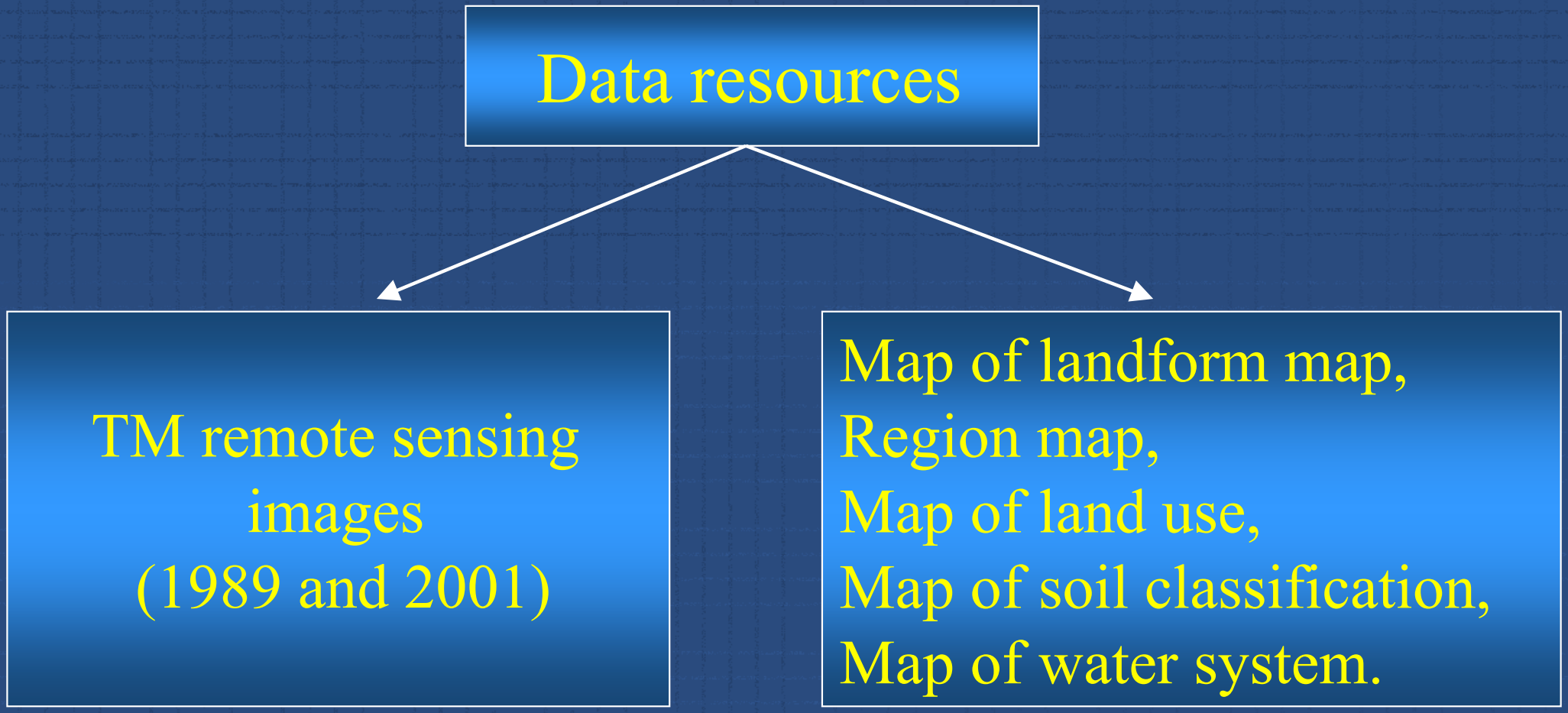
Field work

Saline & alkaline dust storm

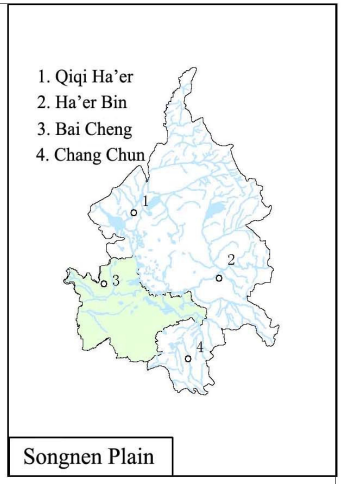
Result of ecological calamity

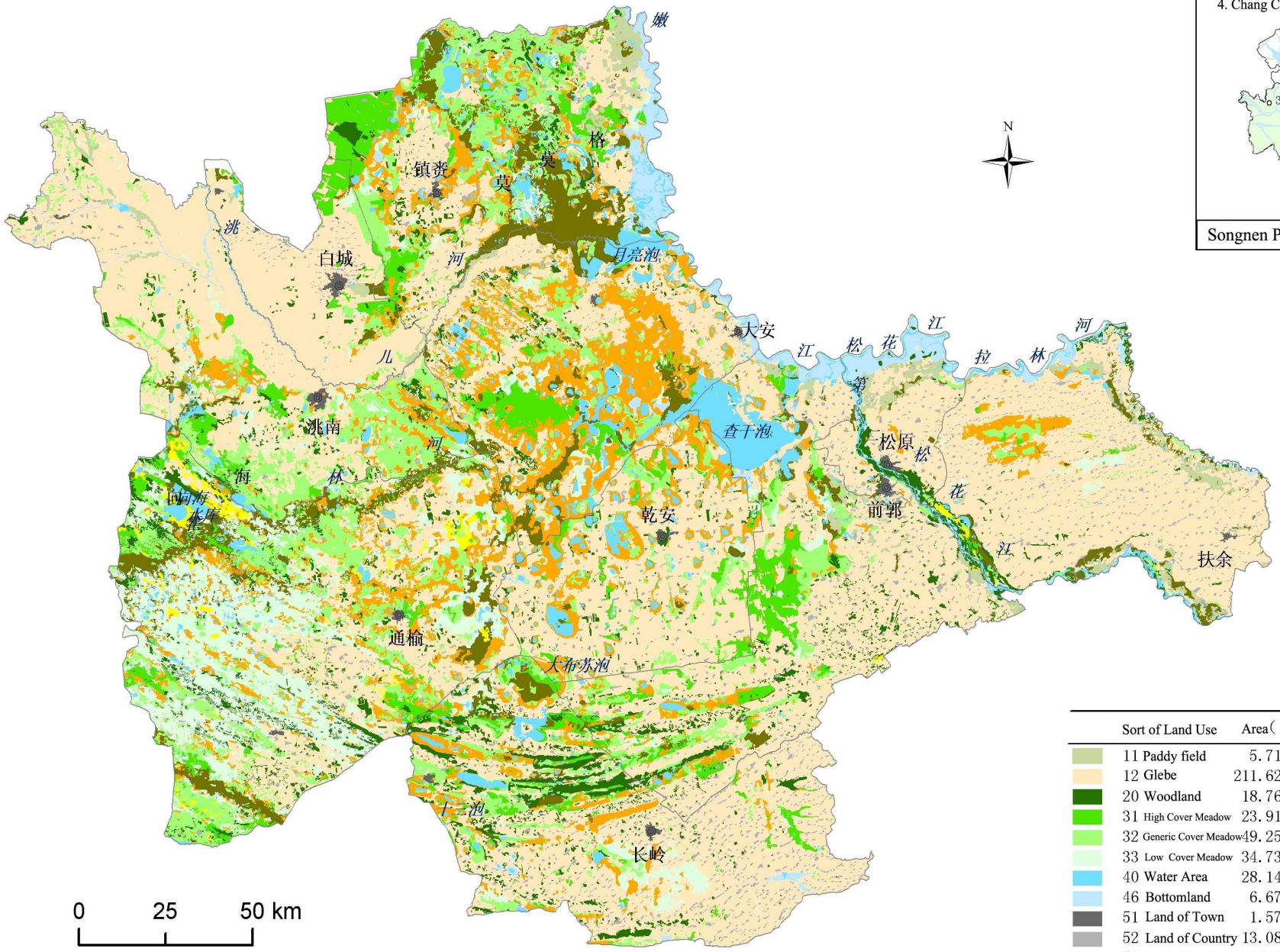
2.2 Land use / land cover change (LUCC)

(1) Information of land use / land cover



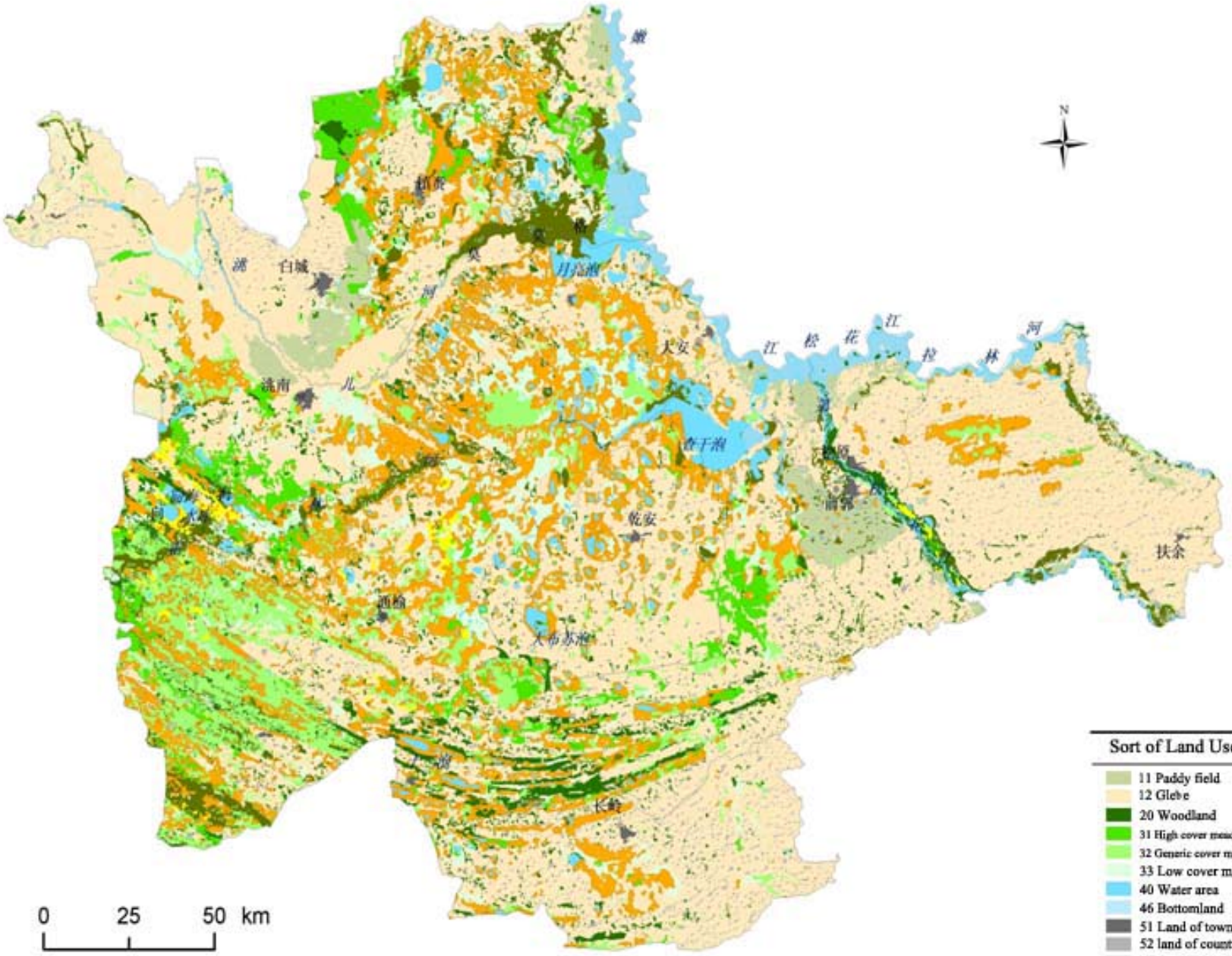
Land use / land cover of the southwest of Songnen Plain in 1989





	Sort of Land Use	Area(10^4 hm^2)	Percent
	11 Paddy field	5.7185	1.2
	12 Glebe	211.6281	45.3
	20 Woodland	18.7662	4
	31 High Cover Meadow	23.9105	5.1
	32 Generic Cover Meadow	49.2504	10.5
	33 Low Cover Meadow	34.7375	7.4
	40 Water Area	28.1494	4.7
	46 Bottomland	6.6752	1.9
	51 Land of Town	1.5702	0.3
	52 Land of Country	13.0847	2.8
	53 Land of Build	0.146	0
	61 Sandy Land	2.7131	0.6
	63 Salina	47.1215	10.1
	64 Marsh	23.8109	5.1

Land use / land cover of the southwest of Songnen Plain in 2001



Sort of Land Use	Area(10^4hm)	Percent
11 Paddy field	14.43	3.1
12 Glebe	225.59	48.3
20 Woodland	20.04	4.3
31 High cover meadow	20.05	4.4
32 Generic cover meadow	38.62	8.3
33 Low cover meadow	26.09	5.6
40 Water area	12.74	2.7
46 Bottomland	9.91	2.1
51 Land of town	1.64	0.4
52 land of country	13.28	2.8
53 Land of build	0.15	0
61 Sandy land	2.9	0.6
62 Salina	62.59	13.4
63 Marsh	18.81	4

Conclusions from the two maps:

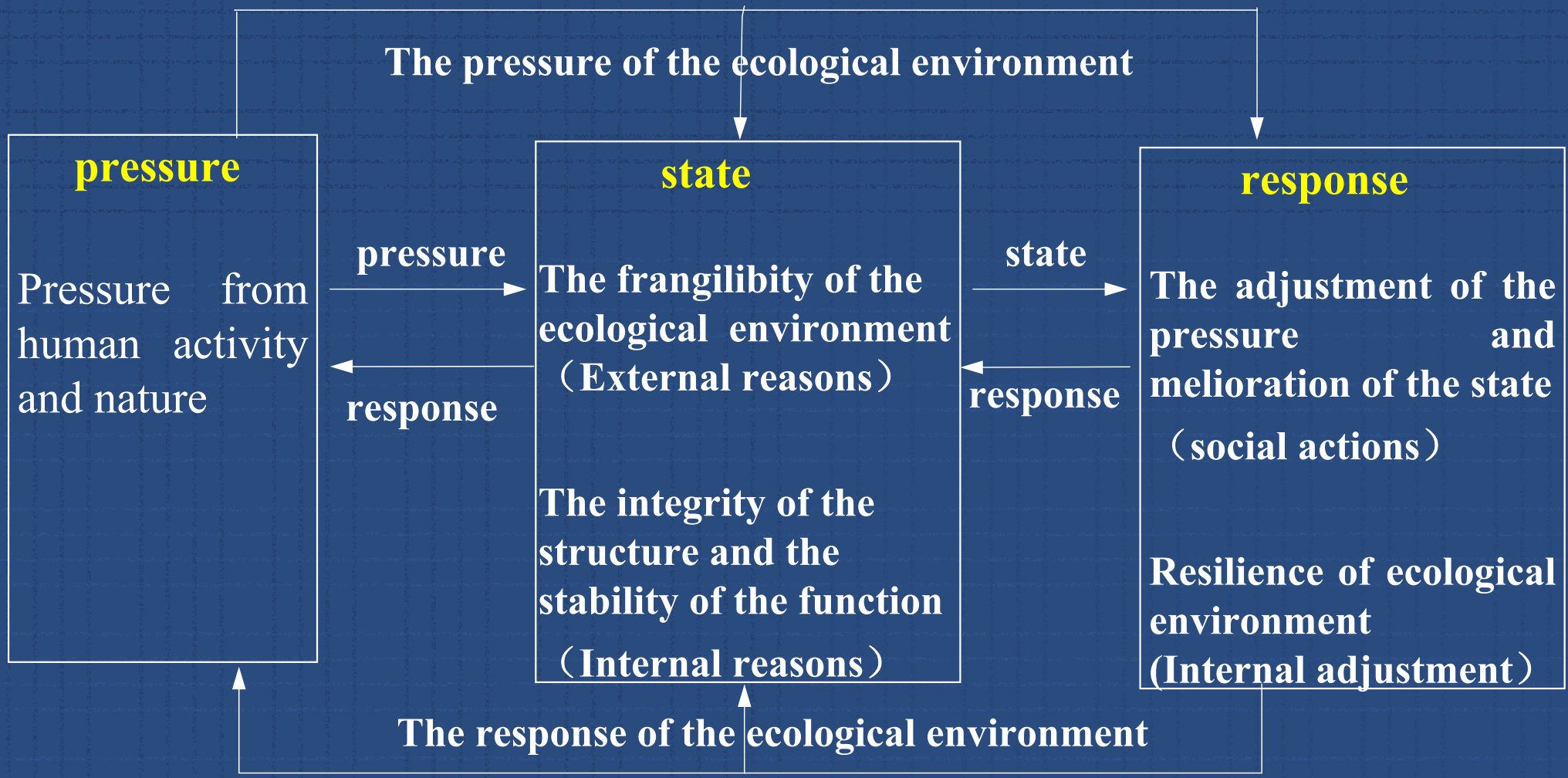
(1)The quantity of land use change

(2)The space & time of land use change

(3)The degree of land use change

2.3 Assessment of land ecological security

- **P-S-R theory frame**



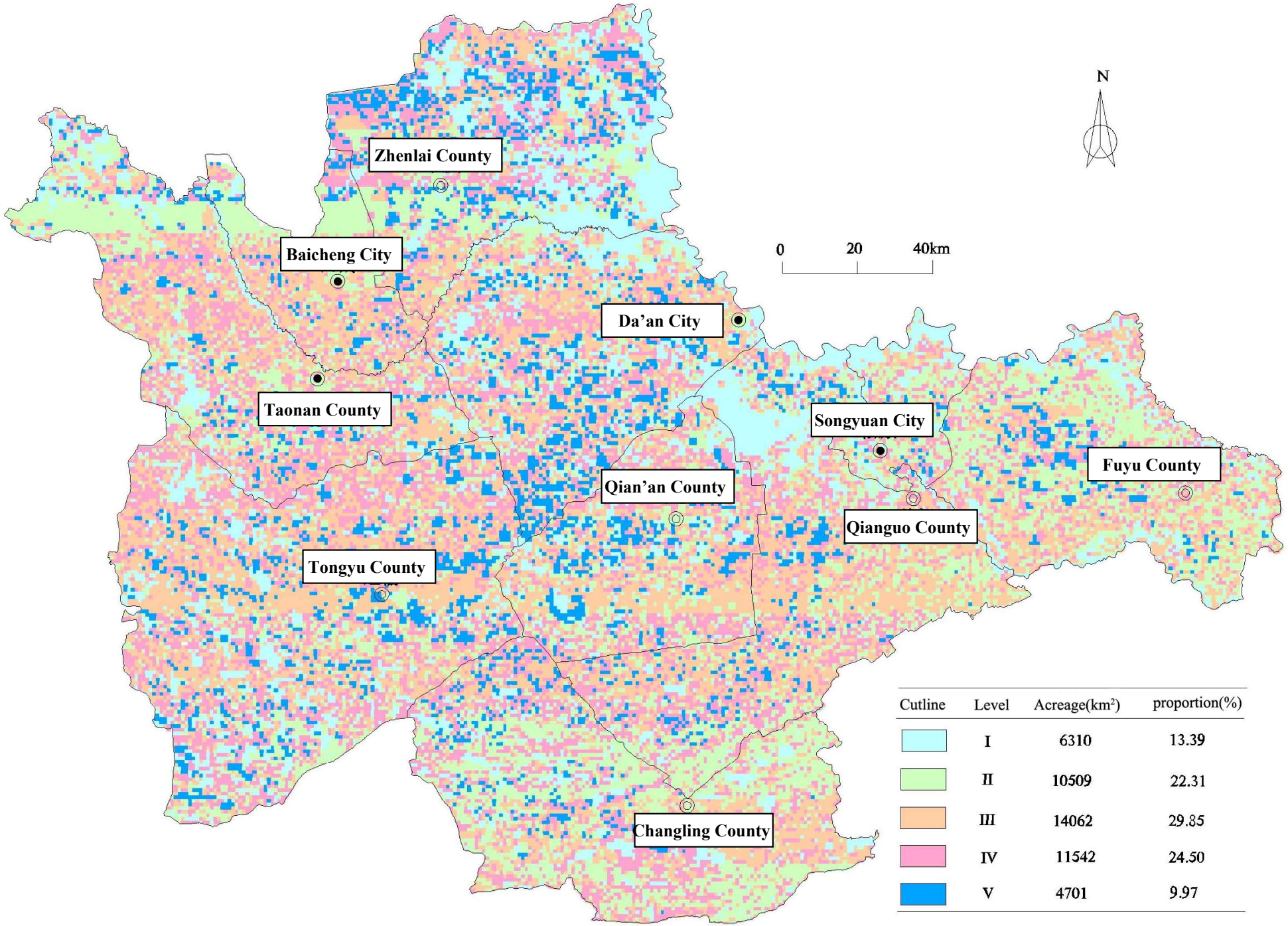
Index system

- Pressure from land ecological environment
  - Pressure from nature
    - Nature calamity index
  - Pressure from human being
    - Population density
    - Acreage of plantation (glebe & woodland) per person
    - Quantity of water resource per person
    - Quantity of foodstuff requirement
- State of land ecological environment
  - Frangibility of the system
    - Acreage of salina per person
    - Acreage of sandy land per person
  - Integrality of the structure
    - Index of drought
    - Character of soil
    - Vegetation fraction
  - Stability of the function
    - Fragmentation of landscape
    - Intensity of agriculture exploitation
    - Intensity of stockbreeding exploitation
- Response from human being
  - Rejuvenation of the system
    - Flexibility of the ecological environment
    - Intensity of human disturbing
  - Adjustment of pressure and improvement of state
    - The investment of ecology construction / GDP
    - Engle coefficient

Criterion system

Index	Standard of Classification				
	I	II	III	IV	V
Population density (person/hm^2)	<20	20-80	80-120	120-160	>160
Index of drought	<1	1-2	2-3	3-4	>4
Intensity of agriculture exploitation (10,000yuan/km^2)	>16	16-12	12-8	8-5	<5
Intensity of stockbreeding exploitation (10,000yuan/km^2)	>6	6-4.5	4.5-2.5	2.5-1	<1
Character of soil	>8	8-6	6-4	4-2	<2
Quantity of foodstuff requirement (kg)	<8000	8000-18000	18000-28000	28000-35000	>35000
Engle coefficient (%)	<47	47-50	50-53	53-56	>56
Vegetation fraction(%)	>10	10-7	7-5	5-3	<3
Fragmentation of landscape	<0.1	0.1-0.3	0.3-0.6	0.6-0.9	>0.9
Acreage of plantation per person(km^2/person)	>0.03	0.03-0.02	0.02-0.01	0.01-0.005	<0.005
Acreage of woodland per person(km^2/person)	>0.03	0.03-0.02	0.02-0.01	0.01-0.005	<0.005
Acreage of glebe per person(km^2/person)	>0.03	0.03-0.025	0.025-0.02	0.02-0.01	<0.01
Intensity of human disturbing（%）	>0.8	0.8-0.6	0.6-0.4	0.4-0.2	<0.2
Nature calamity index(%)	<1	1-5	5-10	10-15	>15
Quantity of water resource per person（m^3/person）	>1000	1000-800	800-600	600-500	<500
Acreage of sandy land per person(km^2/person)	<0.01	0.01-0.02	0.02-0.03	0.03-0.04	>0.04
Acreage of salina per person(km^2/person)	<0.01	0.01-0.02	0.02-0.03	0.03-0.04	>0.04
Flexibility of the ecological environment	>0.05	0.04-0.05	0.04-0.03	0.03-0.02	<0.02
The investment of ecological construction / GDP（%）	>0.04	0.04-0.03	0.03-0.02	0.02-0.01	<0.01

Result of the assessment 1



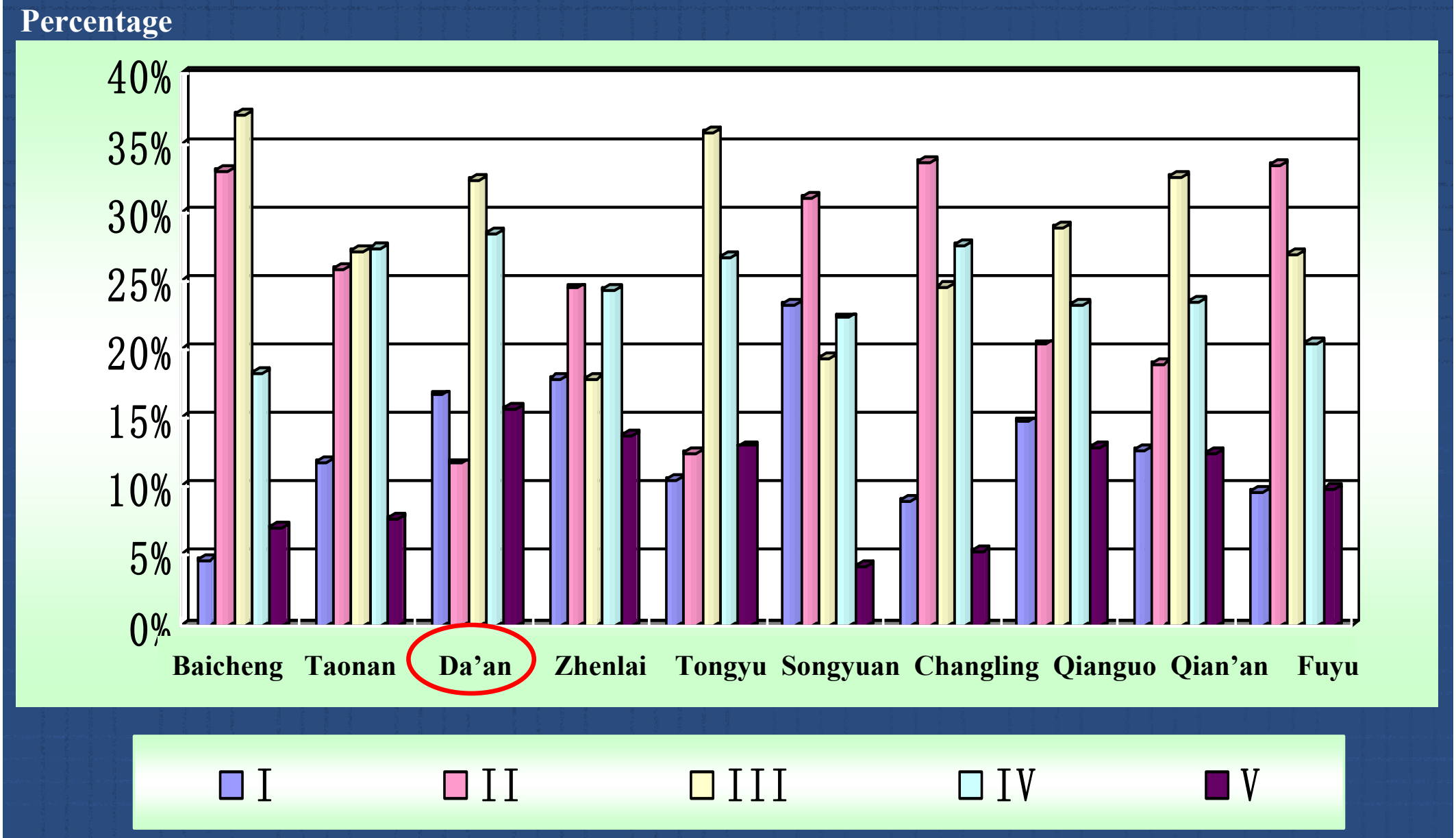
Cutline	Level	Acreage(km²)	proportion(%)
	I	6310	13.39
	II	10509	22.31
	III	14062	29.85
	IV	11542	24.50
	V	4701	9.97

Results of the assessment 2

Unite：km^2，％

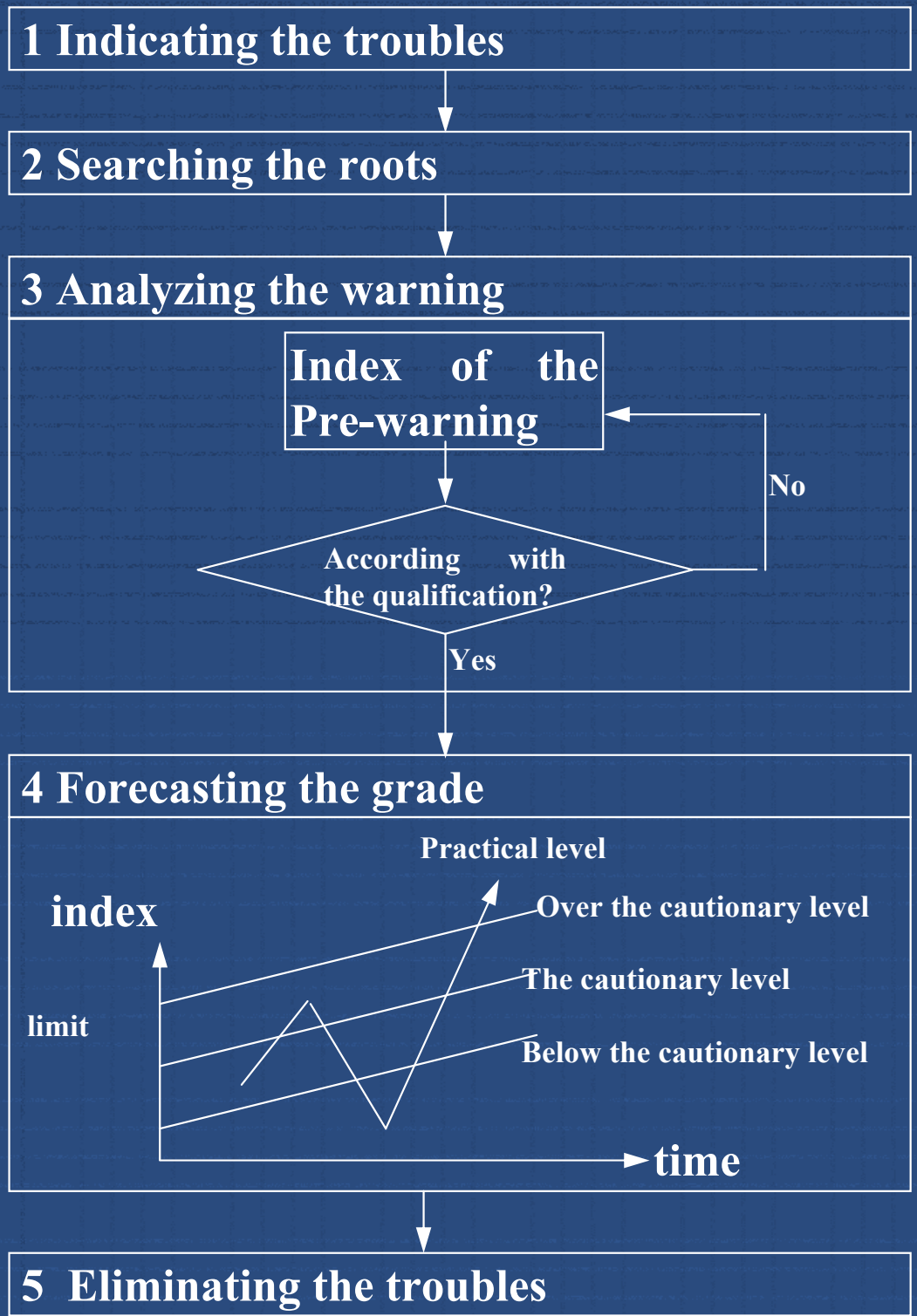
Area	Number of the girds	Total proportion	I level (best)		II level (good)		III level (general)		IV level (worse)		V level (worst)	
			acreage	proportion	Acr.	Pro.	Acr.	Pro.	Acr.	Pro.	Acr.	Pro.
Total	47114	47114	6310	13.39	10509	22.31	14062	29.85	11542	24.5	4701	9.97
Baicheng	1818	1818	84	4.59	599	32.98	675	37.11	331	18.23	129	7.09
Taonan	4968	4968	590	11.87	1283	25.83	1347	27.1	1362	27.42	386	7.77
Da'an	4879	4879	813	14.66	570	13.69	1576	28.41	12501	24.61	671	15.63
Zhenlai	5232	5232	929	19.76	1278	22.43	934	17.86	1273	22.32	818	13.74
Tongyu	8097	8097	846	10.45	1006	12.42	2897	35.78	2298	24.38	1050	12.97
Songyuan	1210	1210	280	23.17	375	31.01	235	19.4	266	22.28	50	4.14
Changling	5729	5729	517	9.02	1923	33.56	1410	24.61	1581	27.6	298	5.21
Qianguo	6920	6920	1016	14.71	1407	20.33	2003	28.94	1602	23.15	890	12.88
Qian'an	3218	3218	407	12.66	607	18.86	1046	32.5	757	23.52	401	12.46
Fuyu	5043	5043	482	9.56	1682	33.35	1361	26.98	1028	20.38	492	9.76

Results of the assessment 3

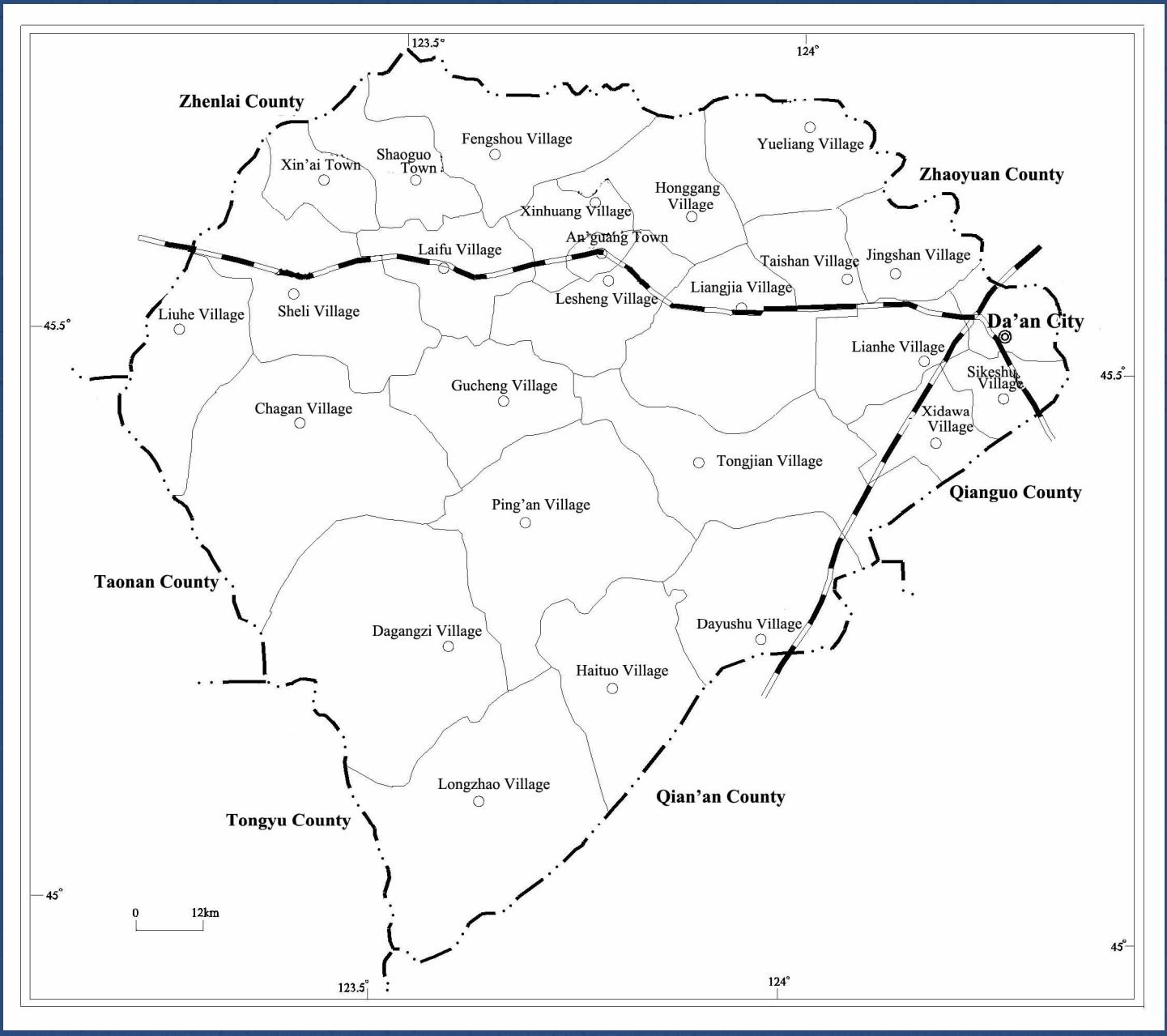


2.4 Pre-warning of land ecological security

principle



(1) Indicating the troubles



✓ Index system of the Pre-warning

	Index	I Safe	II Mild	III Moderate	IV Serious	V Terrible
Pre-warning state	Degree of land salinization（%）	<5	5-20	20-40	40-60	>60
	Degree of meadow degradation（%）	<5	5-20	20-40	40-60	>60
Pre-warning source	Percentage of organic matter（%）	>4	4-2	2-1	1-0.5	<0.5
	Percentage of the quantity of total salt（%）	<0.5	0.5-1	1-2	2-3	>3
	Percentage of the quantity of alkali （%）	<10	10-30	30-50	50-70	>70
	Vagetation fraction（%）	>70	70-50	50-30	30-10	<10
	Use efficiency of the plantation（%）	>0.7	0.5-0.7	0.3-0.5	0.2-0.3	<0.2
	Calamity index	<0.1	0.1-0.3	0.3-0.6	0.6-0.9	>0.9
Pre-warning sign	Quantity of agriculture product(t/hm^2)	>6	6-4	4-2	2-1	<1
	Quantity of nature grass product（t/hm^2）	>1.0	1.0-0.7	0.7-0.5	0.5-0.1	<0.1

✓ Precaution limit

Grade of the warning	Safe	Low grade	Middle grade	Serious grade	Terrible grade
Precaution limit	>0.65	0.55-0.65	0.45-0.55	0.45-0.35	<0.35

(2) Searching the roots

As the mechanism of catastrophology and dynamics of the land ecology, the sources of the security are included the internal stress, external stress and human stress.

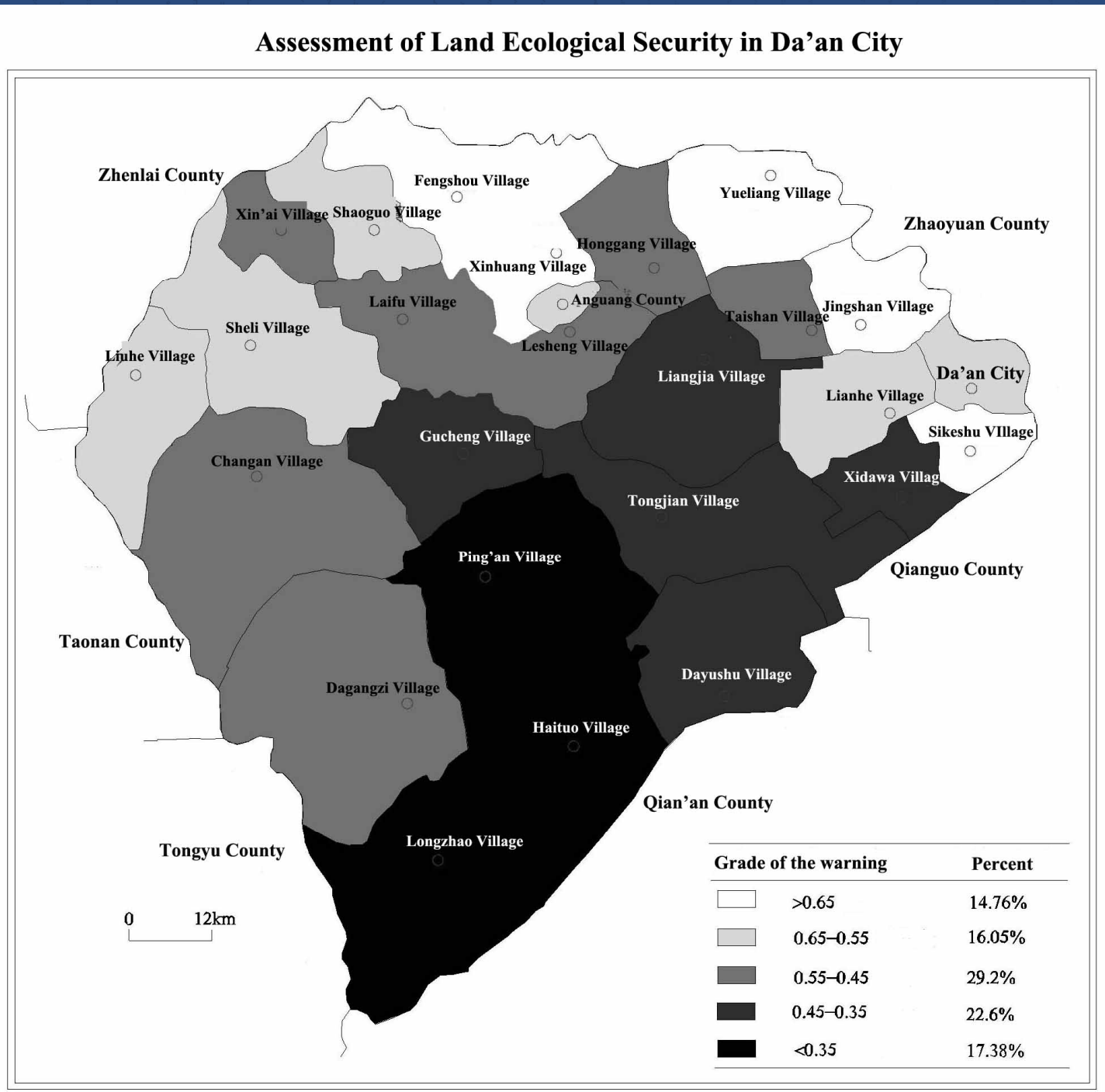
$$Y(t) = \begin{bmatrix} E_n(t) \\ E_x(t) \\ H_m(t) \end{bmatrix}$$

En(t)——Internal stress， soil condition;

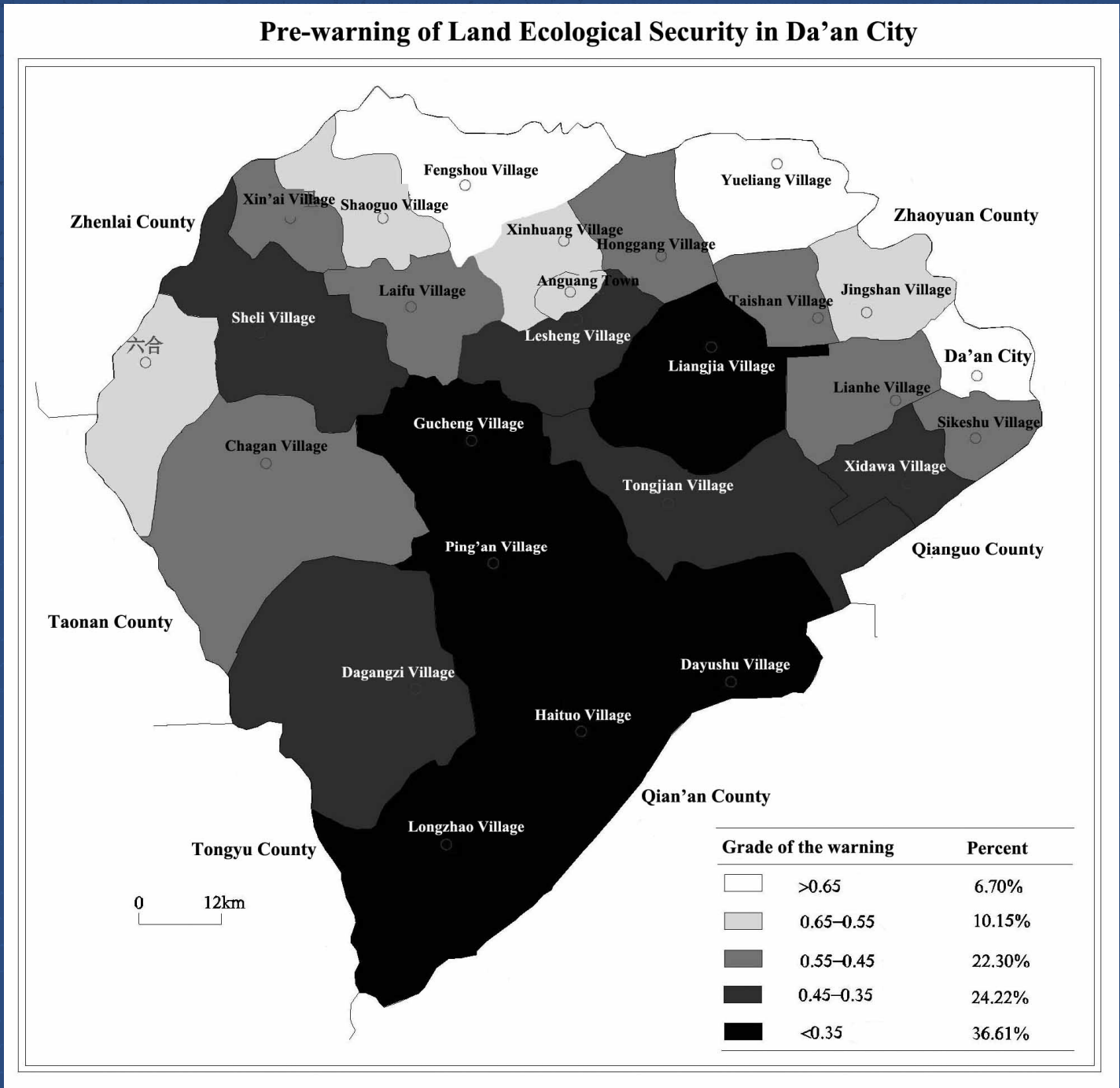
Ex(t)——External stress， climatic factors and calamity factors ;

Hm(t)——Human stress, human activities changed the land cover and leaded to the land ecological environment problems indirectly.

(3) Analyzing the warning



(4) Forecasting the grade



(5) Eliminating the troubles

- Preventive measures such as hydraulic engineering and biology remediation were put forward to the safe, mild and moderate areas.

- Adjustive measures such as remediation of land salinization and meadow degradation were put forward to the serious and terrible areas.

3.Conclusions

In this research, the RS, GIS and EIS were used to studying the land use/ land cover change, evaluating and pre-warning the land ecological security in the area of the southwest of Songnen Plain in China.

The result indicated that the state of land ecology in the southwest of Songnen Plain was in dangerous. Da'an city was the most serious one. Therefore, pre-warning of the land ecological security was carried in Da'an city as the sample. Preventive measures and adjustive measures were put forward to prevent the deterioration finally.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