



# Identifying Land Use-Cover Changes Using High-Resolution Satellite Images: a Case Study in Lower Reaches of Tumen River, China

Department of Geography, Yanbian University, China

Nan Ying, Liu Zifeng, Zhu Weihong

[nanying@ybu.edu.cn](mailto:nanying@ybu.edu.cn)

2009. 9. 7

# Background

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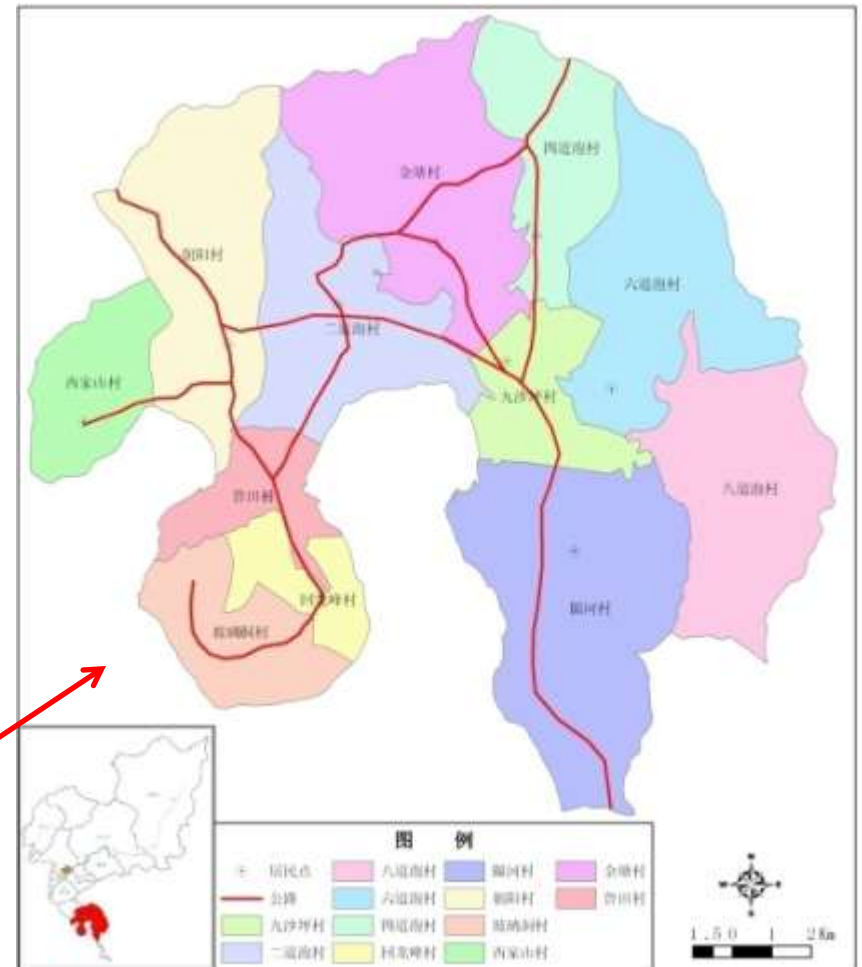
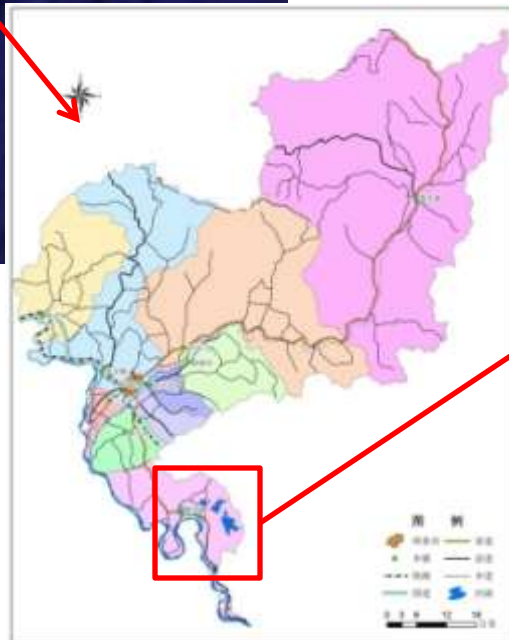
- ❖ With the growth in world population and economic development, land use/cover has changed enormously in the past century (William and John, 2005).
- ❖ In this regard, remote sensing has considerable potential in drawing land cover maps, but the accuracy of the maps derived is often viewed as insufficient (Wilkinson, 1996; Foody, 2002; Dash et al., 2007).
- ❖ High-resolution images should be used to classify land use/cover to improve the accuracy.

# Objectives

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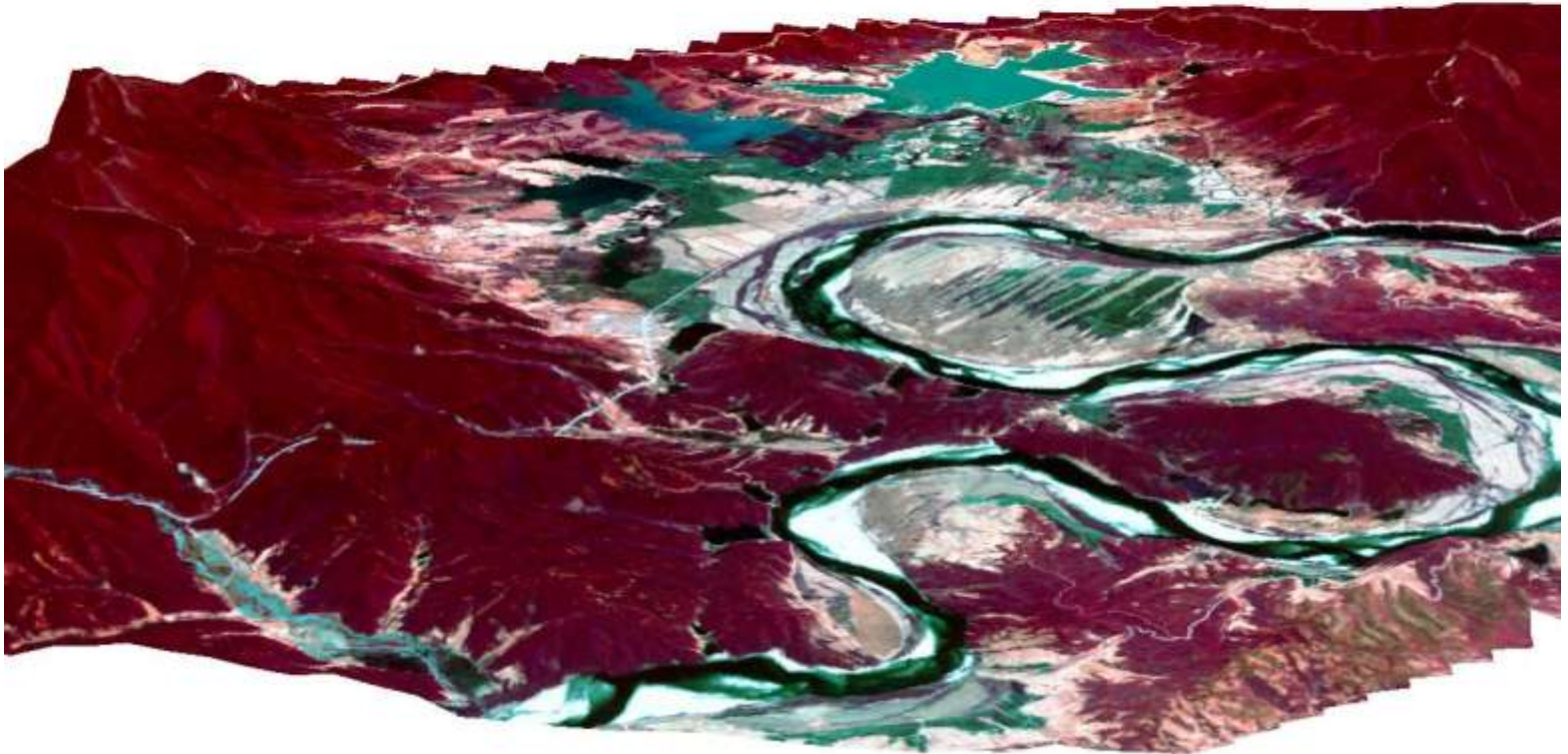
- ❖ To identify and classify land use/cover of Jingxin area, Hunchun City, which is located at the lower reaches of the Tumen River in China, using high-resolution imagery (SPOT-5) taken in 2004.
- ❖ To detect Land Use/Cover Change (LUCC) by comparing these images with land-use maps produced in 1996.
- ❖ To study dynamic changes in landscape patterns, and to evaluate landscape ecological effects by using Landscape Pattern Indexes.

# Study Area



# 3D SPOT5 Image

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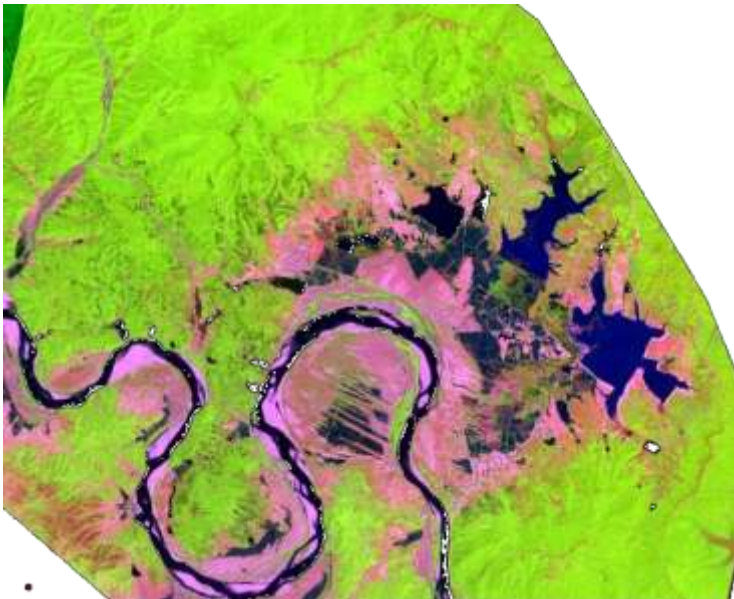




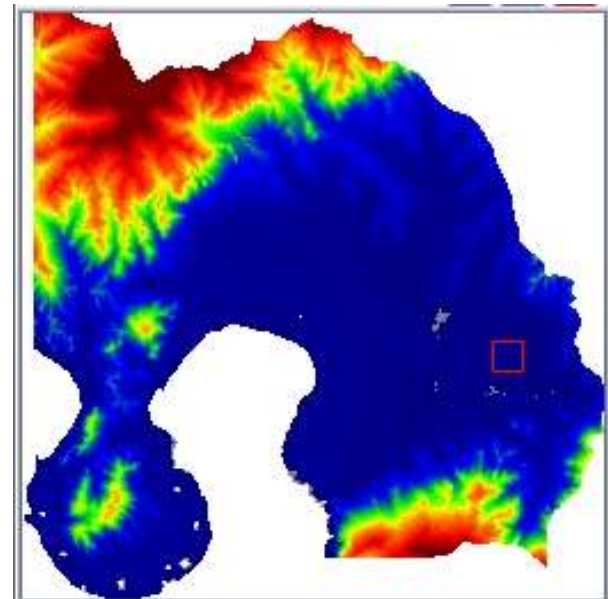
# Data Sources

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- ❖ The land-use map made by the Land Bureau of Hunchun City in 1996.
- ❖ 1:10,000 topographic maps
- ❖ The Digital Elevation Model (DEM)
- ❖ SPOT-5 images taken on June 15, 2004.

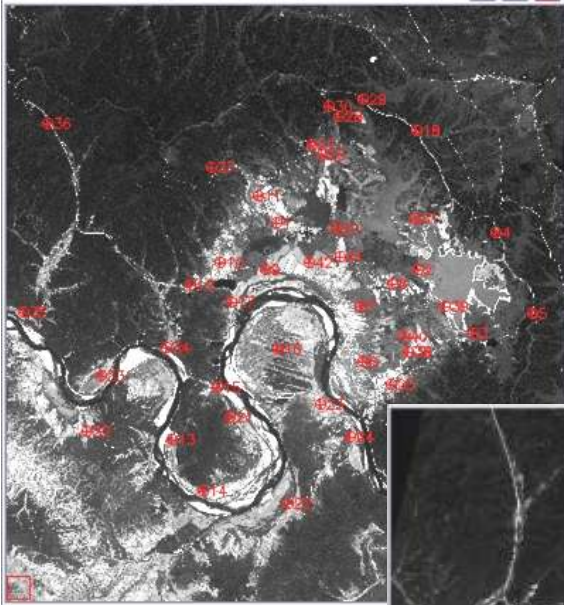


Orthorectified imagery of Jingxin area

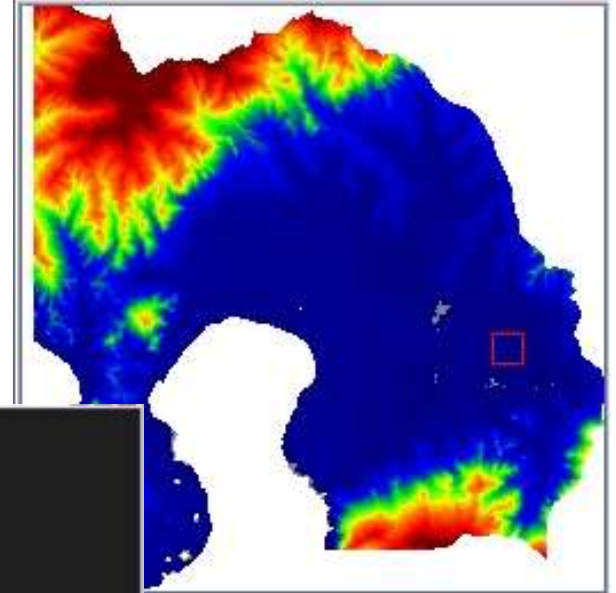
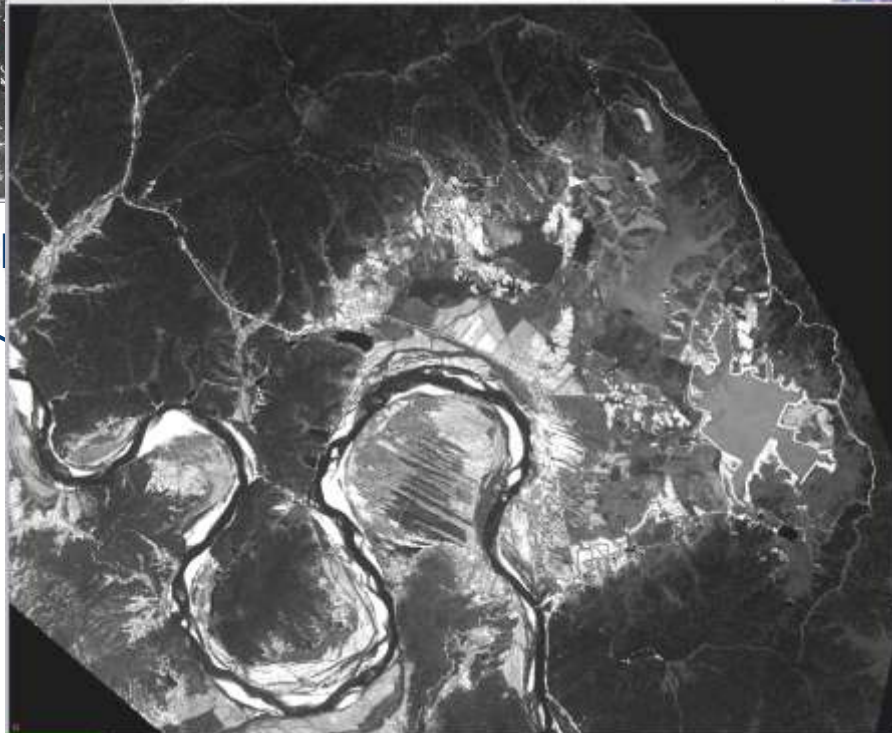


DEM of Jingxin area

# Method—imagery processing



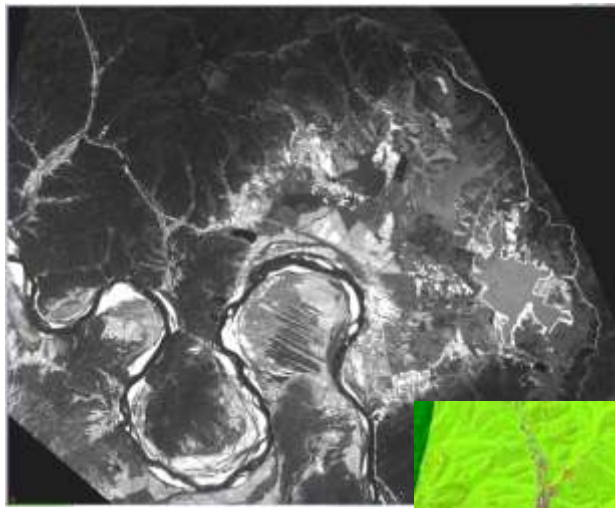
Select GC



DEM

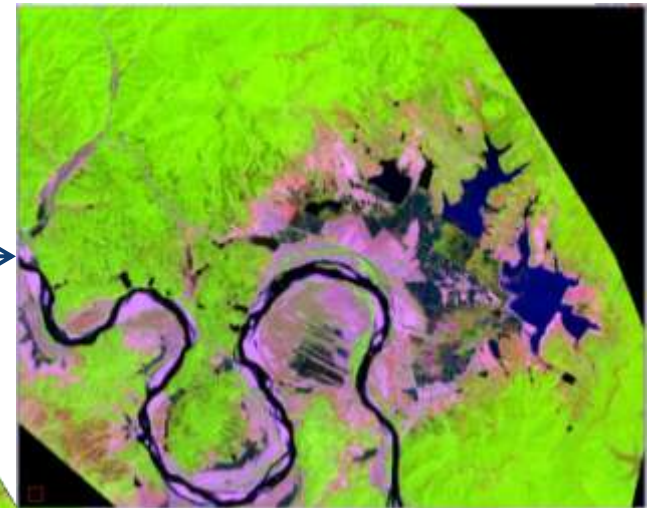


# Method—imagery processing

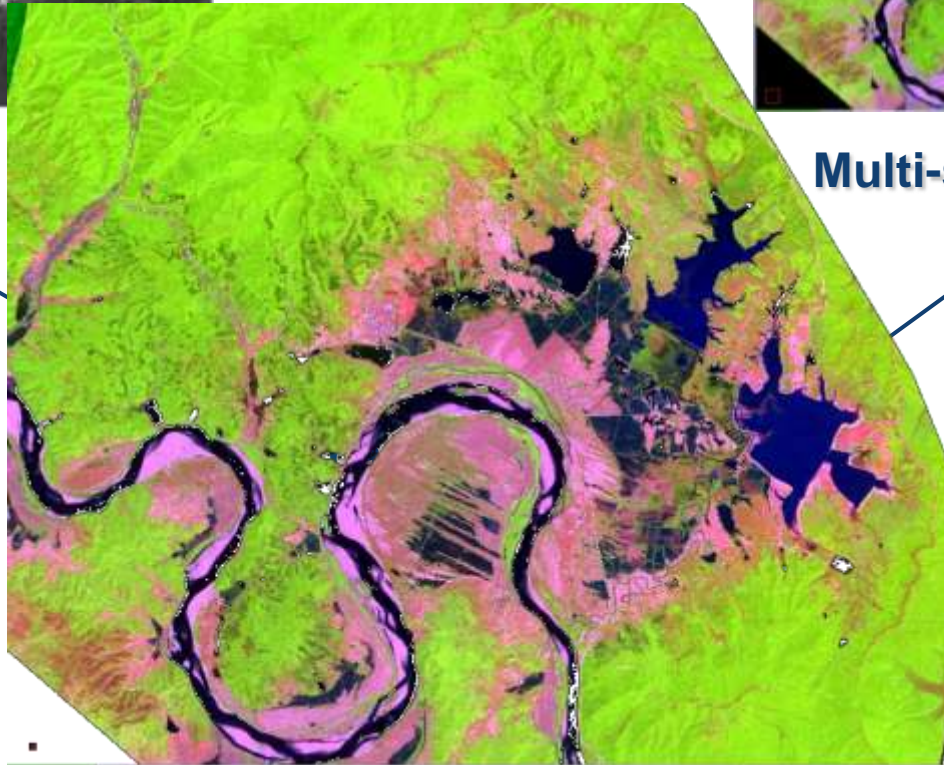


Pan imagery

Registration



Multi-spectral imagery





# Method—interpreting of imagery

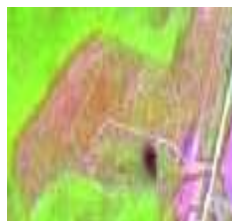
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111 Paddy Field



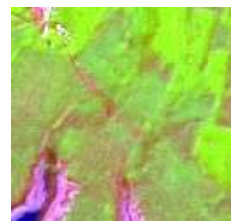
114 Dry Farming Land



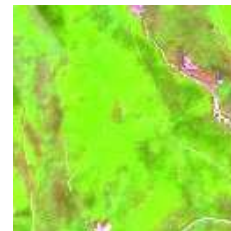
121 Orchard



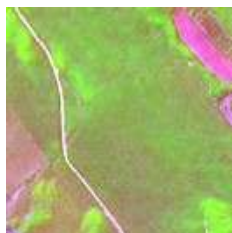
131 Forest land



132 Shrub Land



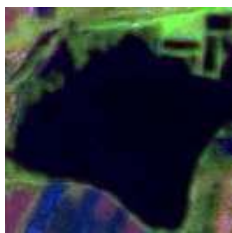
133 Stocked Land



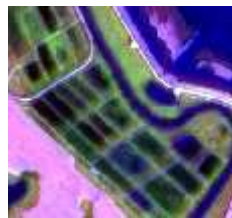
134 Young Plantation



141 Natural Pasture



154 Pond



155 Fishpond



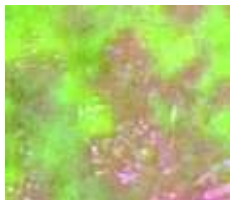
202 Urban land



203 Country Settlement



204 Industrial Land



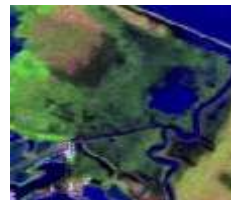
206 Special Use Area



271 Reservoir



311 Waste Grassland



313 Marshland



321 River



324 Tidal Flat

# Classification of Land use Type

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## 11 Farmland

111 Paddy Field, 114 Dry Farming Land

## 12 Garden Plot

121 Orchard

## 13 Woodland

131 Forest land, 132 Shrub Land, 133 Stocked Land, 134 Young Plantation

## 14 Grassland

141 Natural Pasture

## 15 The Other Agricultural Land

154 Pond, 155 Fishpond

## 20 Residential and industrial area

202 Urban land, 203 Country Settlement, 204 Industrial Land, 206 Special Use Area

## 27 Water Conservancy Facility

271 Reservoir

## 31 Unutilized Land

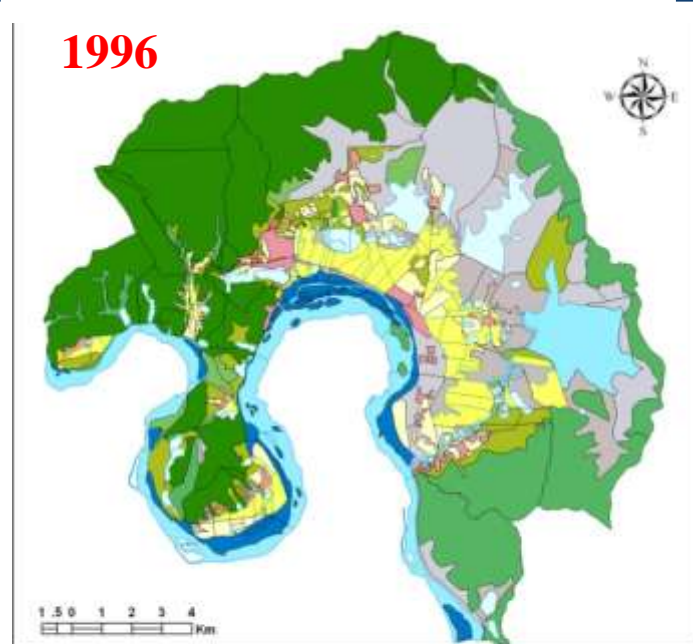
311 Waste Grassland, 313 Marshland

## 32 The other types

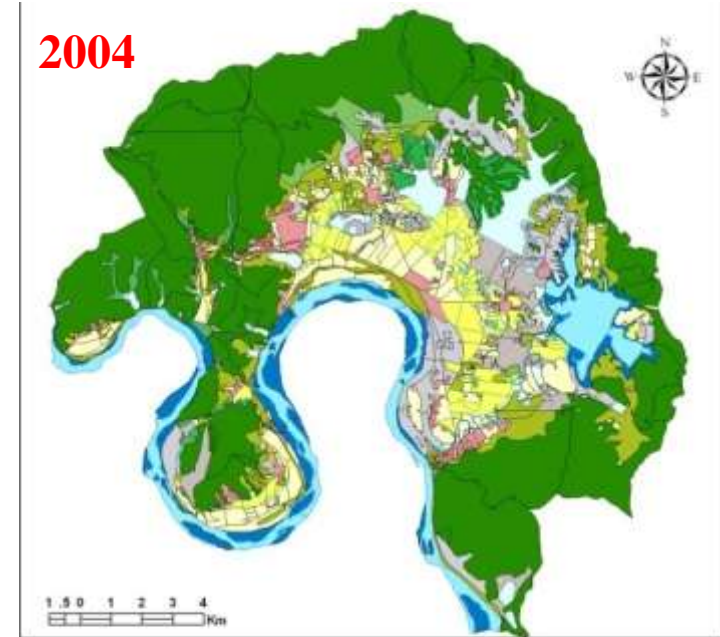
321 River, 324 Tidal Flat

# Method—updating of land use map

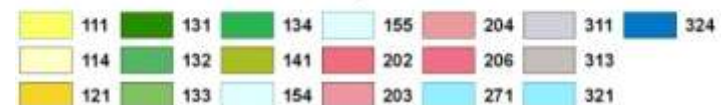
- ❖ This imagery was used as a base imagery, and land use was interpreted and classified by referring to the topographical maps and conducting field investigations. Then the land-use types were statistically analyzed and the land-use map updated based on the interpreted land-use information.



Legend



Legend



# Method—Landscape Pattern Indexes

- ❖ This method uses land-use types as discrete variables and can be used to quantify the characteristics of landscape patterns. Landscape pattern indexes include general pattern indexes and element pattern indexes.
- ❖ Considering the actual situation of the Jingxin study area and the different ecological information provided by landscape pattern indexes, this study selected four main landscape pattern indexes to analyze: Number of Patches (NP), Edge Density (ED), Area Weighted Mean Patch Fractal Dimension (AWMPFD), and Area Weighted Mean Shape Index (AWMSI).

土地利用景观格局指数

指数	表达式	生态意义
斑块数 (NP)	$NP = n_i$	斑块的个数
边缘密度 (ED)	$ED = \sum_{m=1}^i L_m / \sum_{m=1}^i a_m$	单位面积斑块的边界长度
面积加权斑块分维值 (AWMPFD)	$AWMPFD = \sum_{m=1}^i \left[ \left( \frac{2li(0.25 L_m)}{\ln a_m} \right) \left( \frac{a_m}{\sum_{m=1}^i a_m} \right) \right]$	AWMPFD 是反映景观格局总体特征的重要指标，它在一定程度上也反映了人类活动对景观格局的影响。
面积加权形状指数 (AWMSI)	$AWMSI = \sum_{m=1}^i \left[ \left( \frac{0.25 L_m}{\sqrt{a_m}} \right) \left( \frac{a_m}{\sum_{m=1}^i a_m} \right) \right]$	AWMSI 是度量景观空间格局复杂性的重要指标之一，并对许多生态过程都有影响。

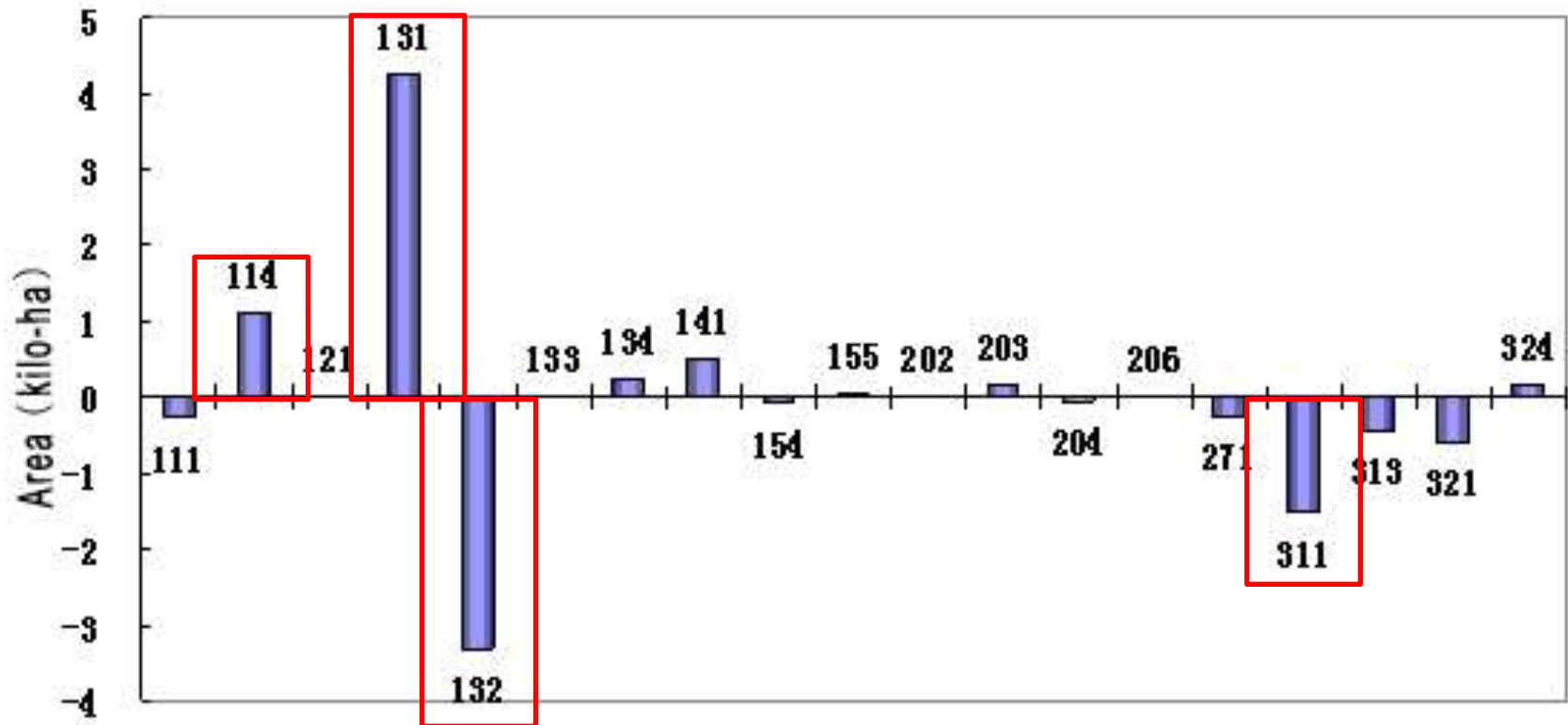


# Result and Discussion

**Table 1. Land use changes in 1996~2004**

Land Use	1996		2004		Changed Area(hm <sup>2</sup> )
	Area(hm <sup>2</sup> )	Percent(%)	Area(hm <sup>2</sup> )	Percent(%)	
Farmland	2534	10.90	3361	14.47	827
Garden Plot	18	0.08	25	0.11	7
Woodland	10248	44.08	11437	49.23	1189
Grassland	1288	5.54	1810	7.79	522
The Other Agricultural Land	1022	4.40	971	4.18	-51
Residential and industrial area	522	2.25	641	2.76	119
Water Conservancy Facility	777	3.34	533	2.29	-244
Unutilized Land	4148	17.84	2183	9.40	-1966
The other types	2696	11.59	2272	9.78	-424

# Result and Discussion



**Figure 1. Net Changes of Land Use Area in 1996~2004**

111 Paddy Field, 114 Dry Farming Land, 121 Orchard, 131 Forest land, 132 Shrub Land, 133 Stocked Land, 134 Young Plantation, 141 Natural Pasture, 154 Pond, 155 Fishpond, 202 Urban land, 203 Country Settlement, 204 Industrial Land, 206 Special Use Area, 271 Reservoir, 311 Waste Grassland, 313 Marshland, 321 River, 324 Tidal Flat

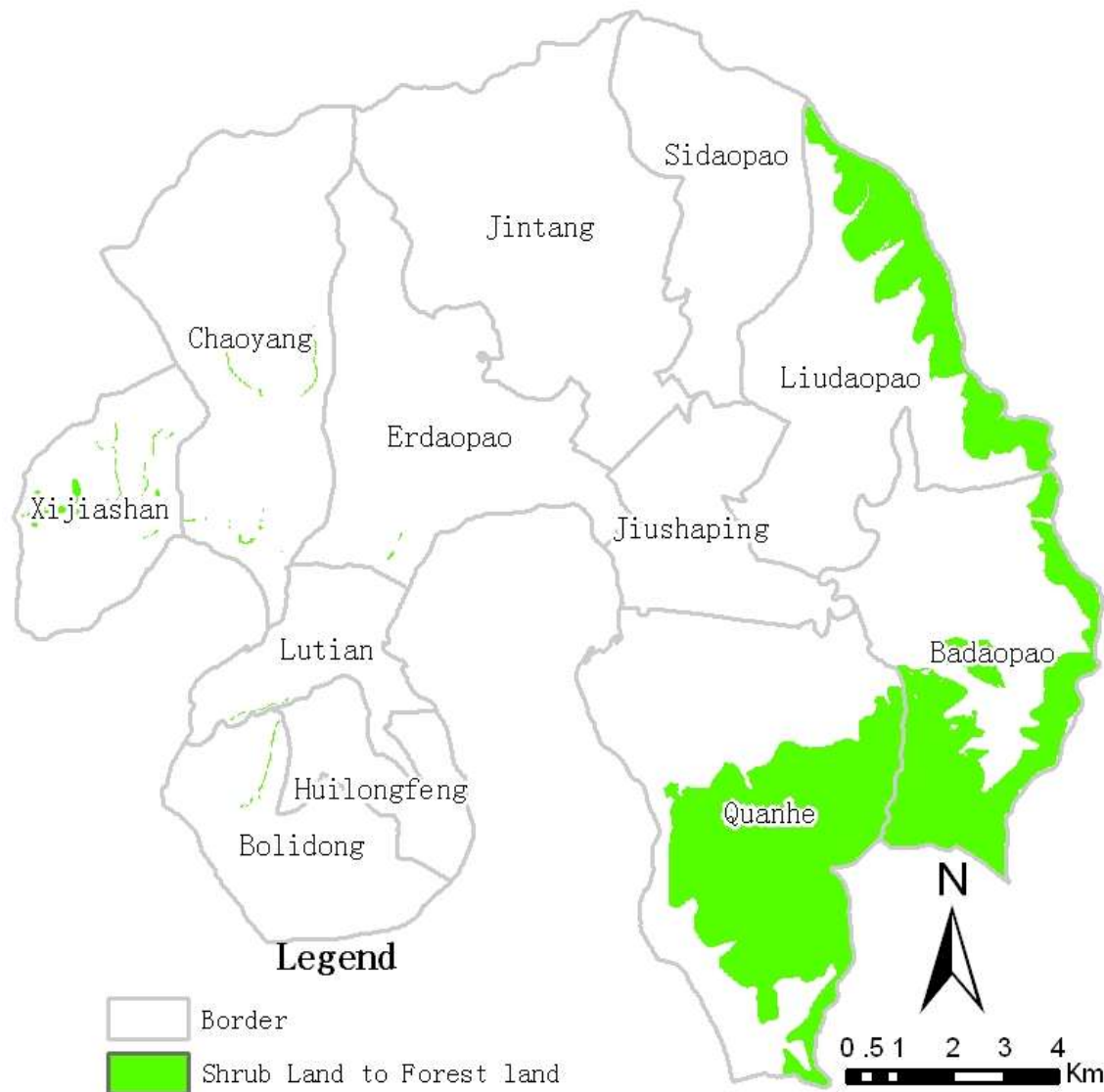
# Result and Discussion

**Table 2. Conversion Matrix of LUCC in 1996~2004(hm<sup>2</sup>)**

	111	114	121	131	132	133	134	141	154	202	203	204	206	271	311	313	321	324
111	873.7	120.6		2.4	1.4		1.8	68.9	27.9		13.4			18.8	22.8	108.4	4.6	3.6
114	480.5	691.7	2.2	23.1	29.6	3.3	2.2	147.8	35.5	1.6	17.2	7.7	2.3	40.7	151.9	102.3	60.9	288.1
121	3.8	0.5	8.7	5.7				2.5	0.3		1.5	1.6						
131	0.9	11.4	5.3	6297.5	3123.9	96.2	0.6	44.6	28.8		12.7		0.9	33.6	964.2	18.1	2.0	15.8
132	0.1	7.6		3.3	136.6		2.4	7.4	39.9						16.2		7.6	7.7
133				0.2		67.9			8.4						226.0			
134		0.2				61.8	1.3		6.2			6.3			170.7			
141	63.0	49.9	1.1	9.9	23.5	4.4	3.8	636.3	66.4		2	16.4		32.7	343.0	255.8	93.4	167.6
154	19.9	18.9		4.9	9.0	0.7		42.5	657.4		2.7			0.3	83.6	88.2	0.6	1.2
155					2.5				6.8							31.1	0.3	
202		1.4					3.8			15.0	0.1							
203	13.2	41.0	0.2	19.3	18.9	0.6		39.2	9.6	0.4	372.2		0.2		48.2	37.8	0.5	1.4
204						0.8		1.7				3.1			0.5			
206	3.1	1.3							0.4		0.1		6.8					
271	7.4							11.6						476.4	7.3	28.7	1.4	
311	23.6	40.6		7.0	27.6	11.7		188.7	33.4	0.1	3.5	15.5		12.1	798.5	47.1	26.4	111.8
313	29.5	8.6		0.5	89.5			50.3	100.2		0.5				12.5	528.0	15.4	
321	0.3	4.2		0.5	27.7	21.1		5.4	0.2		0.2			1.0	4.3	3.6	1001.1	111.9
324	16.8			2.1	13.8	21.7		37.1	0.5					160.9	20.9	28.5	485.2	147.1

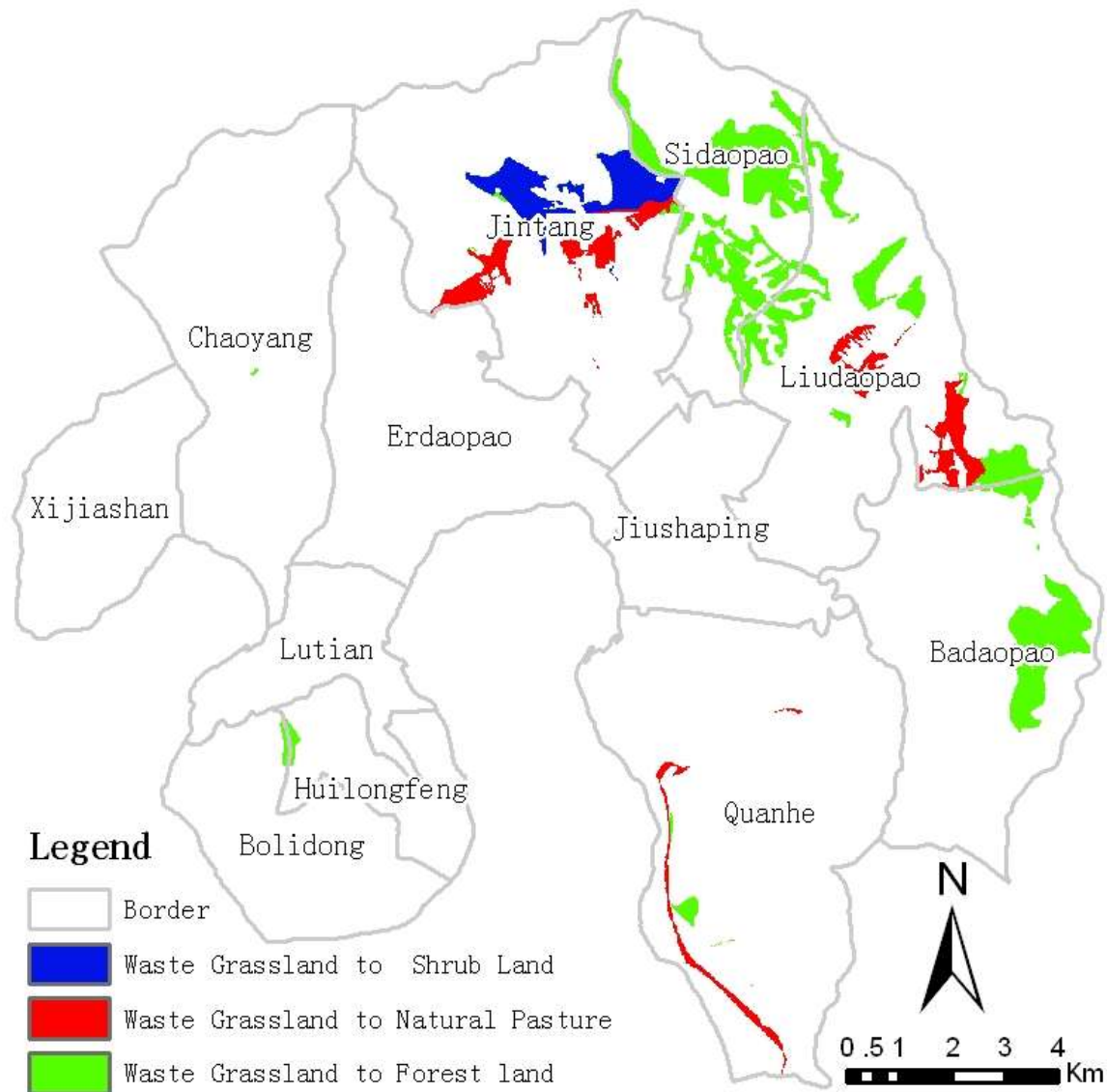
111 Paddy Field, 114 Dry Farming Land, 121 Orchard, 131 Forest land, 132 Shrub Land, 133 Stocked Land, 134 Young Plantation, 141 Natural Pasture, 154 Pond, 155 Fishpond, 202 Urban land, 203 Country Settlement, 204 Industrial Land, 206 Special Use Area, 271 Reservoir, 311 Waste Grassland, 313 Marshland, 321 River, 324 Tidal Flat

# Result and Discussion

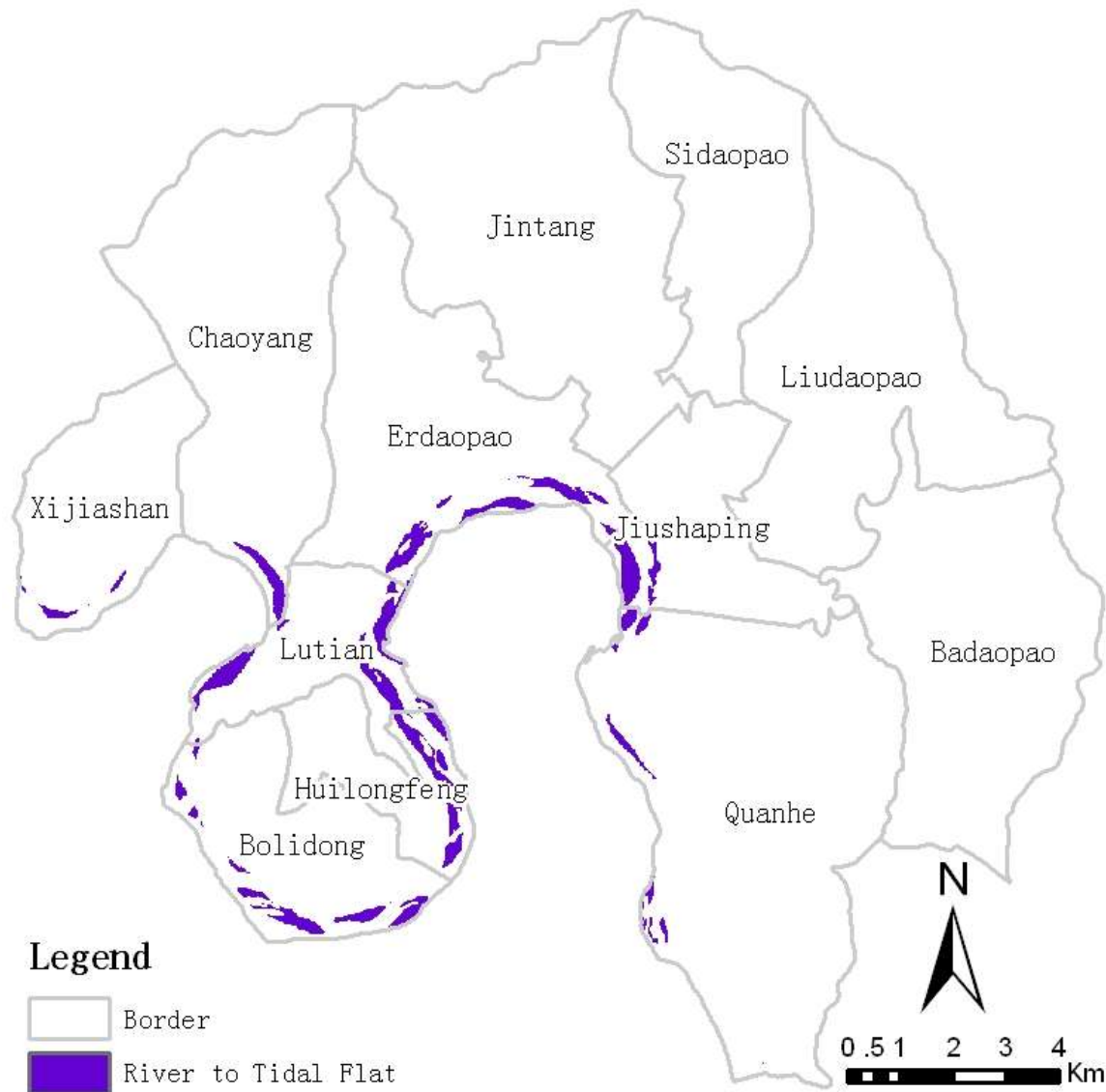




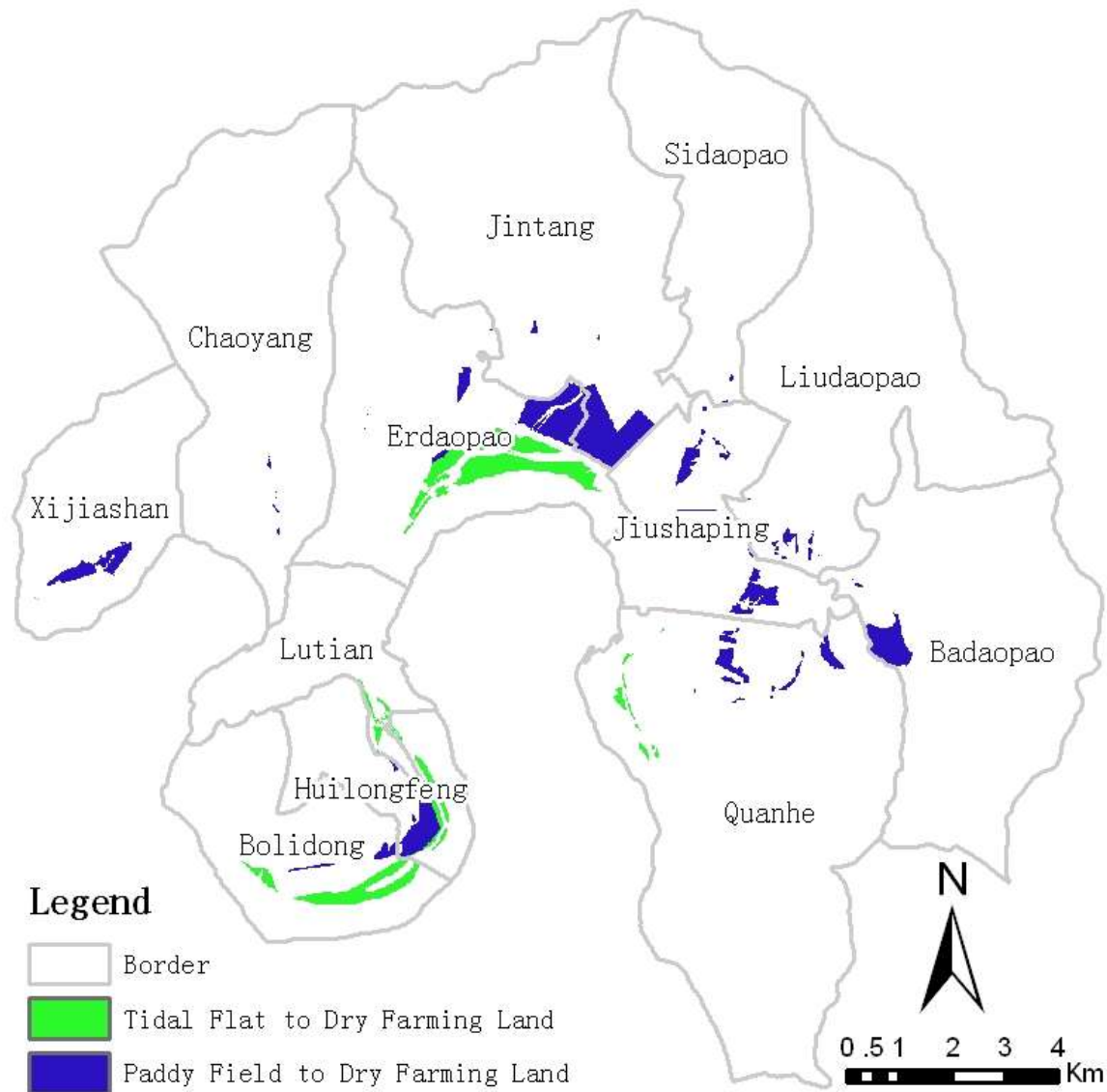
# Result and Discussion



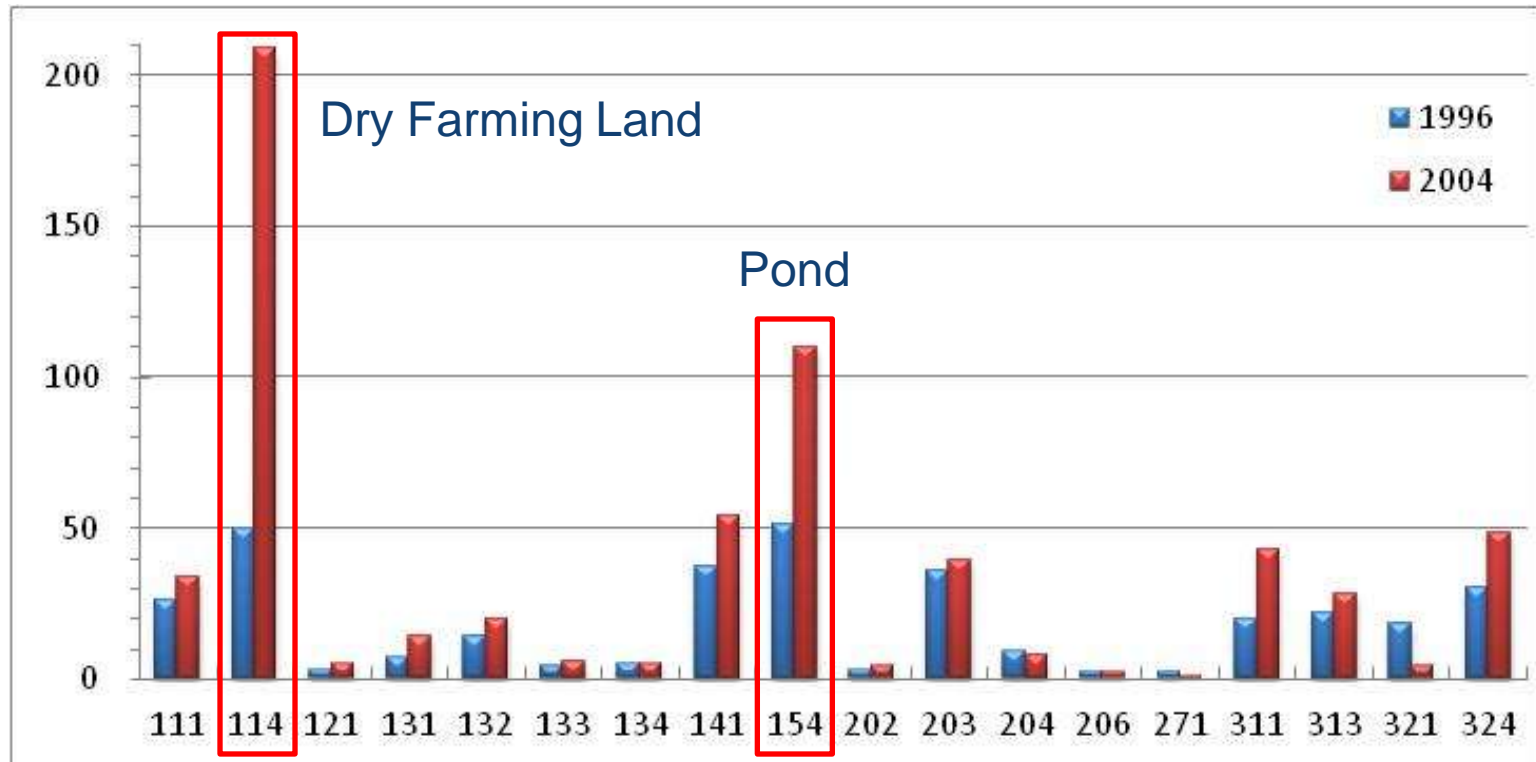
# Result and Discussion



# Result and Discussion



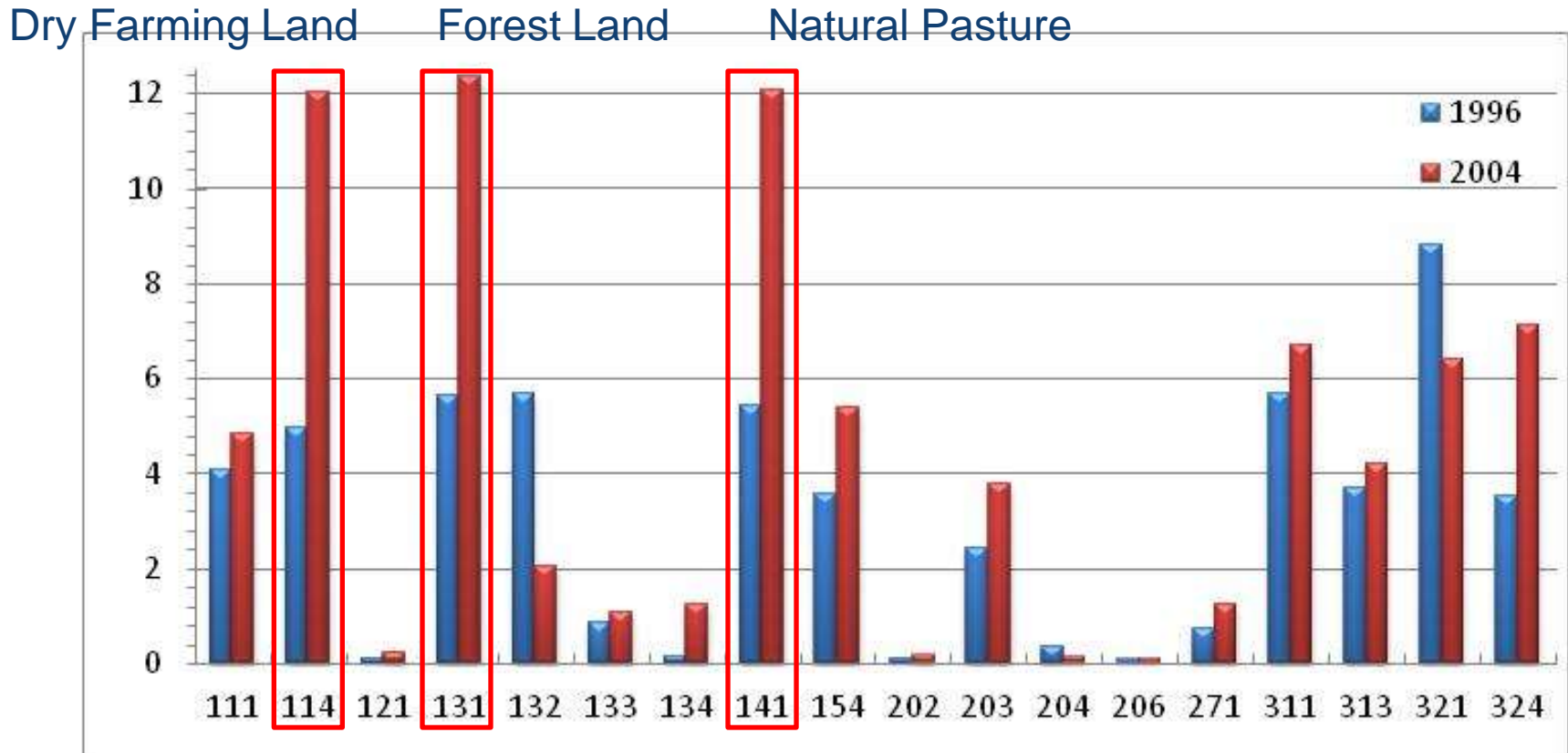
# Result and Discussion



The Changes of NP

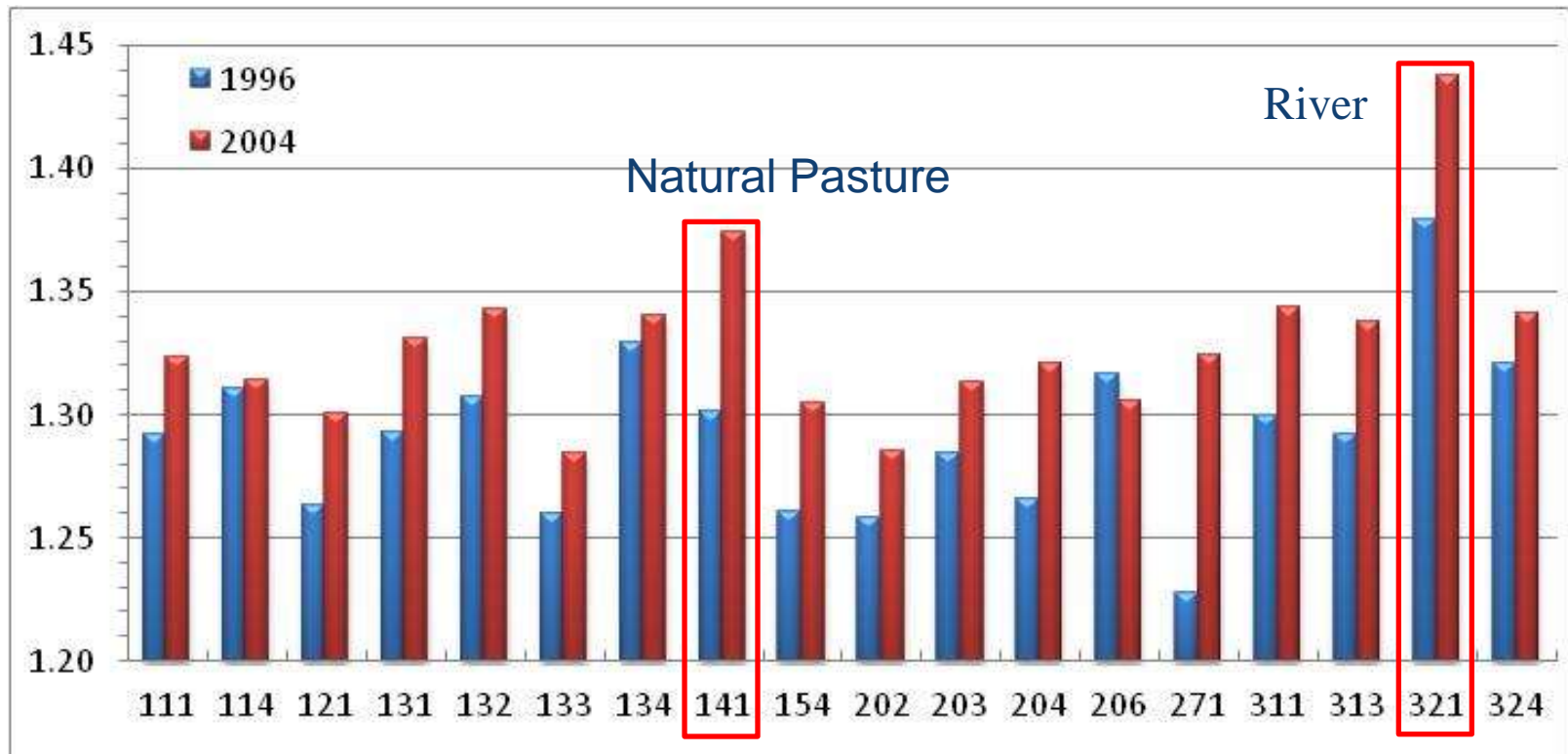


# Result and Discussion



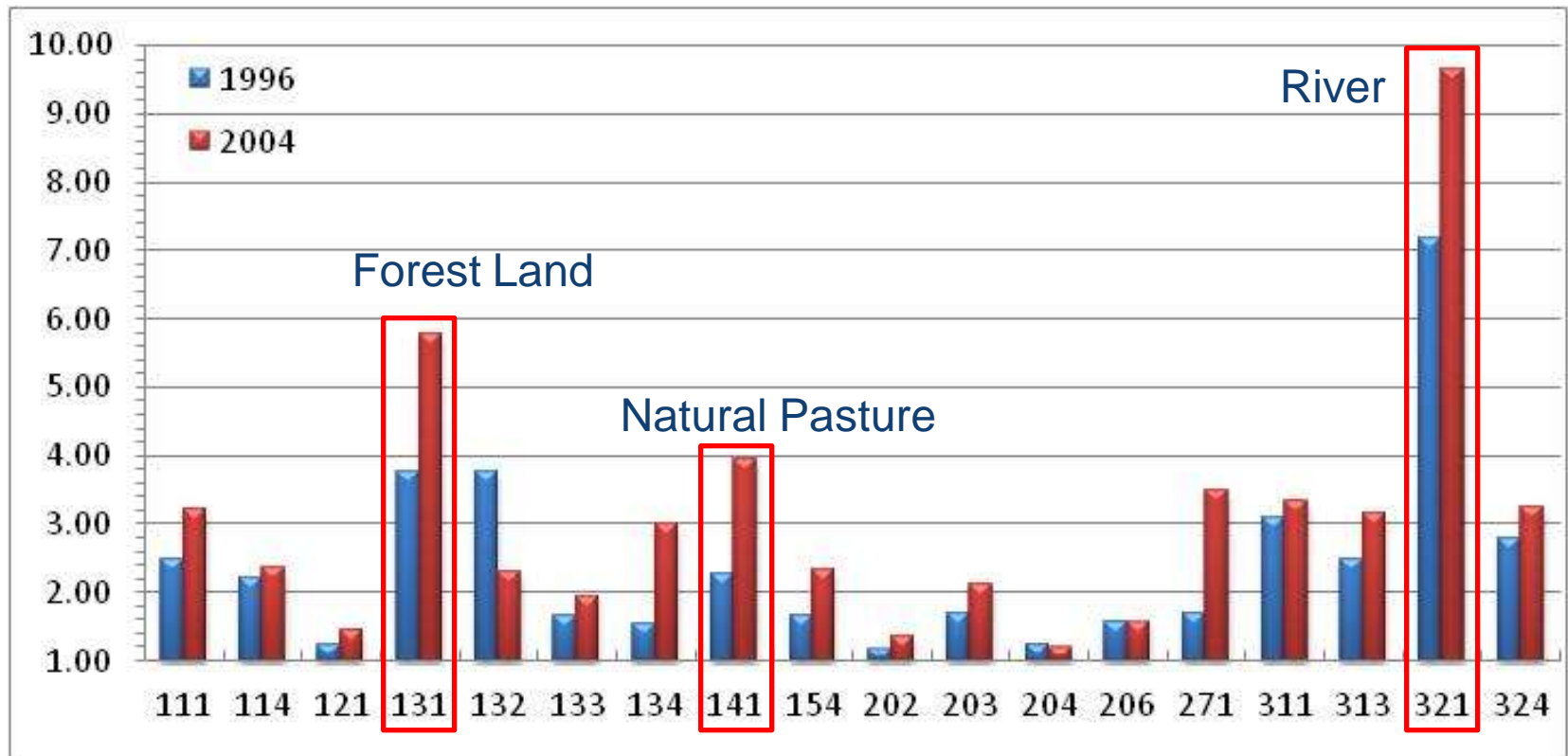
The Changes of ED(m/ha)

# Result and Discussion



The changes of AWMPFD

# Result and Discussion



**The Changes of AWMSI**

# Conclusion

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- ❖ This study discovered the areas of Woodland, Farmland, Grassland, and Residential and Industrial land were increased to different degrees, while the areas of Unutilized Land, Water Conservancy Facility and Other Types were reduced to different degrees.
- ❖ The conversion from Shrub Land to Forest Land was the largest. Conversions from Waste Grassland to Forest Land, from Dry Farming Land to Paddy Field, and from River to Tidal Flat also occurred in different degrees.
- ❖ This study also found that the landscape has been severely fragmented and the natural landscape was greatly affected by human activity in the Jingxin area, particularly the Dry Farming Land, Forest Land, Natural Pasture, Pond, and River areas.





**Thanks for Your Attention**