The fourth session

Regional Effects of Grain for Green Program (GGP)

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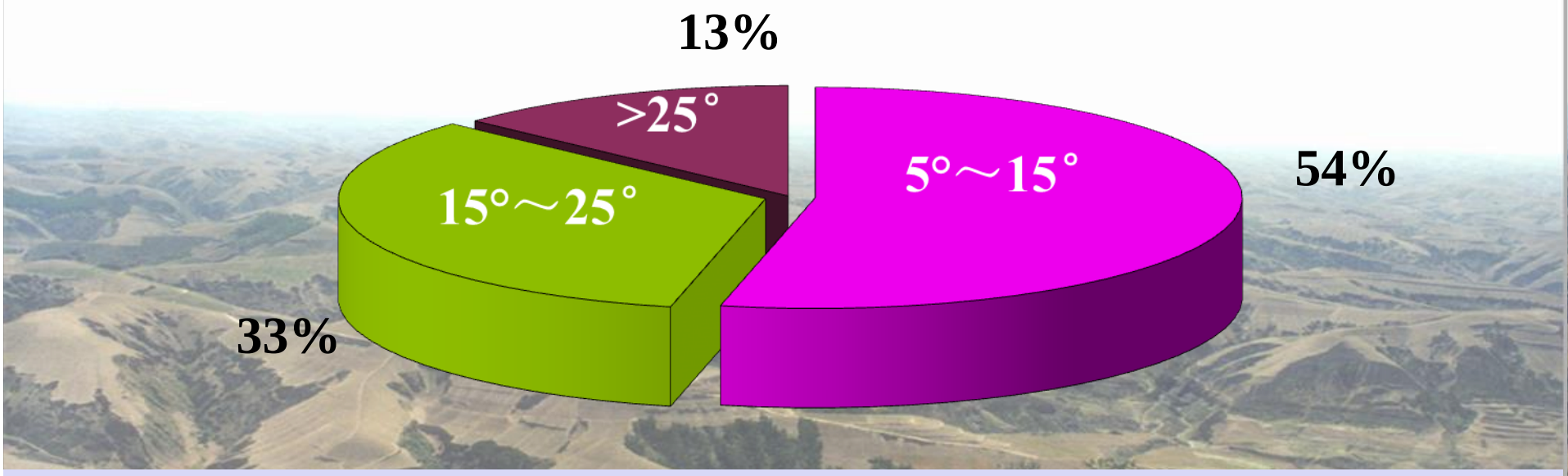
CONTENTS(目录)

- BACKGROUND（背景）
- PROGRESSES （进展）
- IMPACTS （效应）
- DISCUSSION （讨论）

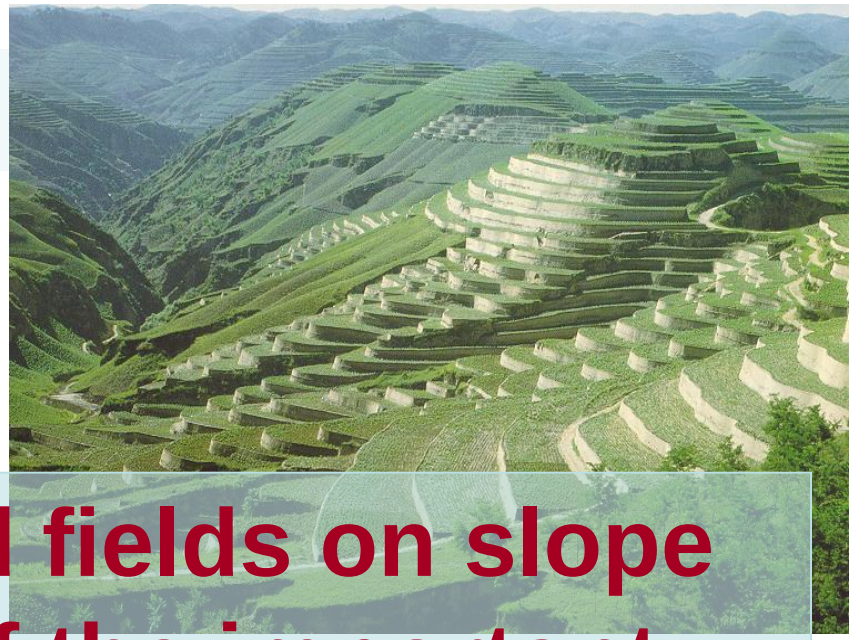
背景 Background of Grain for Green Project (GGP)



In China 2/3 of land are in mountains, hills and plateau regions, 135 million ha. Farmland is on slope land, taking about 50% of total cultivated land

Soil loss from cultivation on steep slope lands
陡坡耕地产生严重的水土流失

Cultivation on slope land to cause soil erosion

To build terraced fields on slope land was one of the important measures to reduce soil erosion

坡地修成梯田可有效地减少水土流失


Terraced fields can control erosion and increase grain yield , but it is consuming.

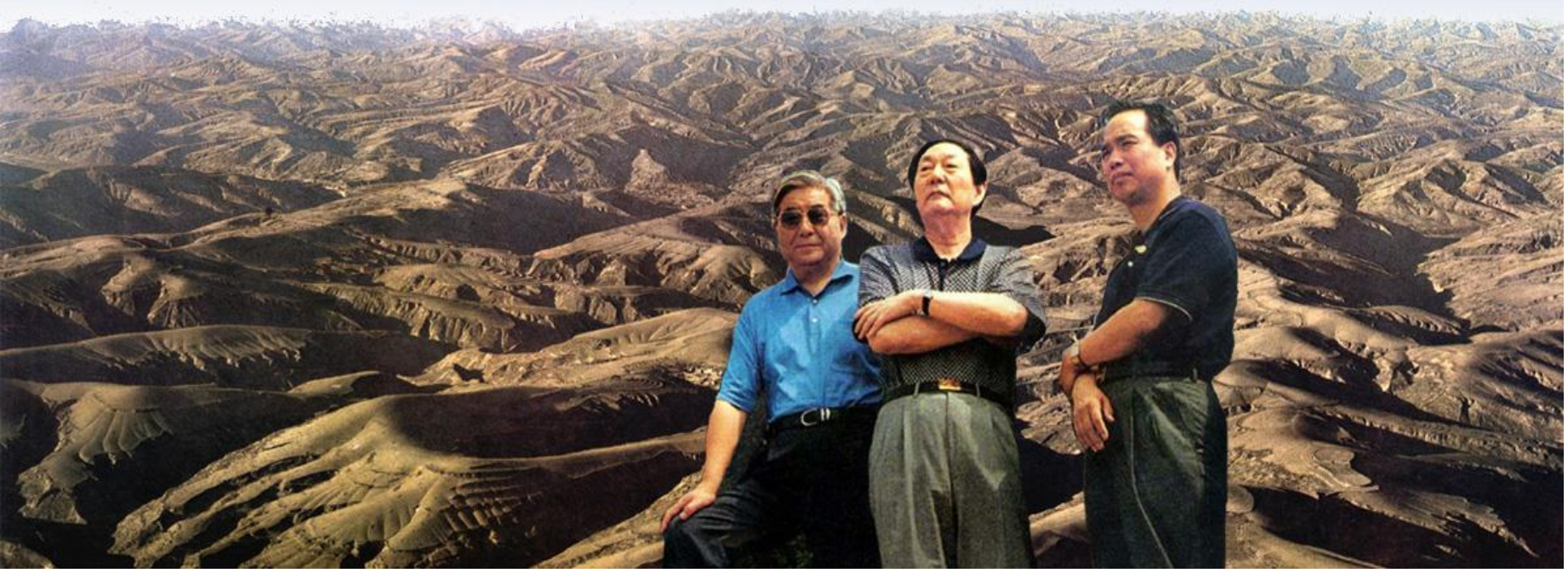
梯田可以控制土壤 侵蚀、增加产量，但需要大量人力、财力和时间

In 1999, The Premier Zhu Rongji inspected soil and water conservation on the Loess Plateau with the Governors of Shaanxi Province

朱镕基和陕西省领导视察黄土高原的水土保持，

对大面积的水土流失陷入了深深的思虑

They were thinking how to do with the broad area suffering soil erosion!



考察后视察水土保持研究所并与科学家讨论提出实施退耕还林（草）工程

After inspection to Loess Plateau they visited our Institute and discussed this issue with scientists. Then the Grain for Green Project was proposed .

To convey cropping land on steep slopes to planting trees/grass (more than 25 degree in southwest region; more than 15 degree in northwest region)南方25以上、北方15度以上的坡耕地都要逐步实行退耕还林（草）

Compensation （国家补贴政策）

Government will give some compensation including grain（粮食）, cash（现金） and seedling fee（种苗费）

South China （南方）

- Grain 2250 kg/ha.year
- Cash 1875 yuan/ha.year
- Seedling fee 750 yuan/ha

North China （北方）

- Grain 1500 kg/ha.year
- Cash 1350 yuan/ha.year
- Seedling fee 750 yuan/ha

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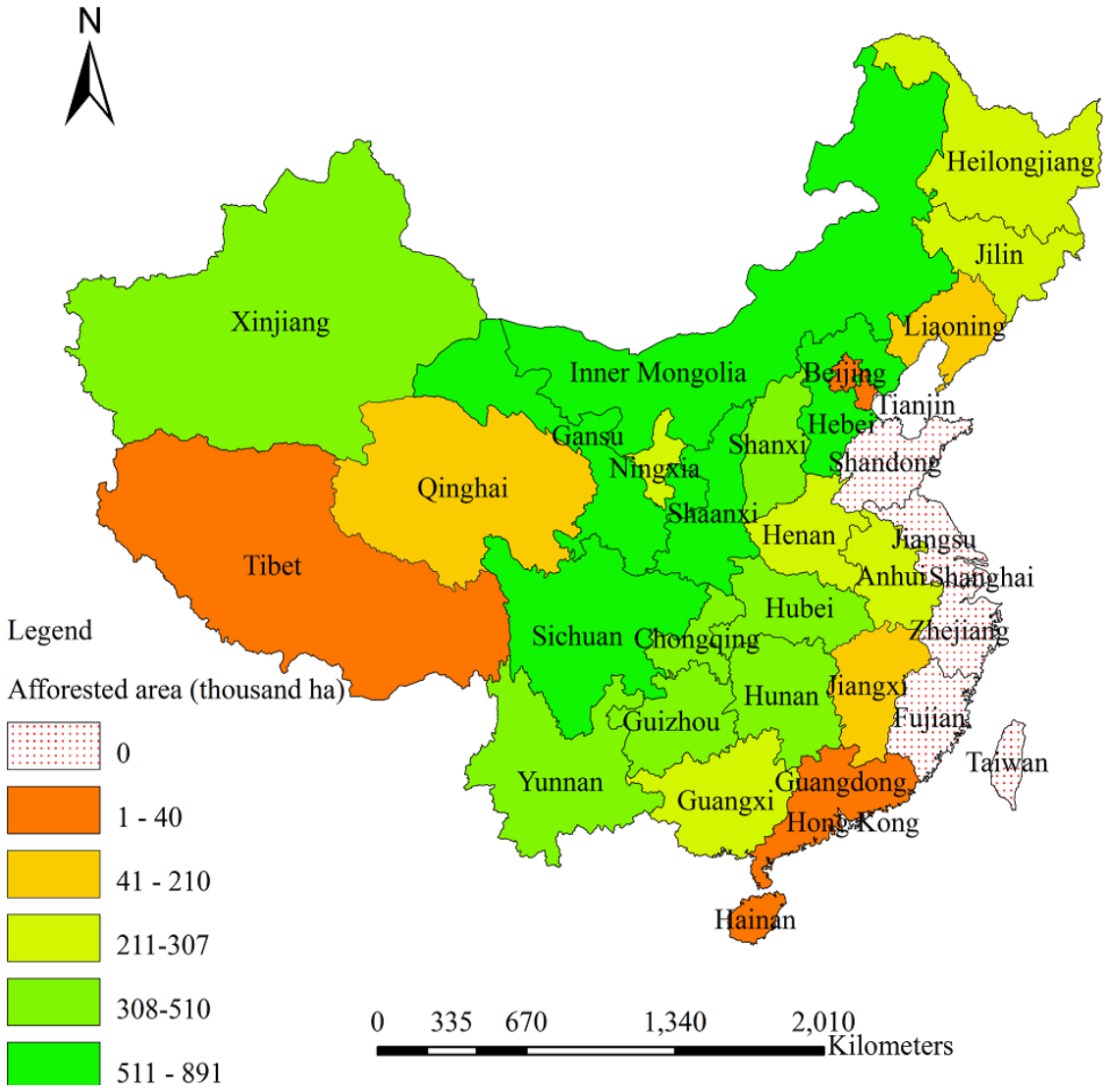
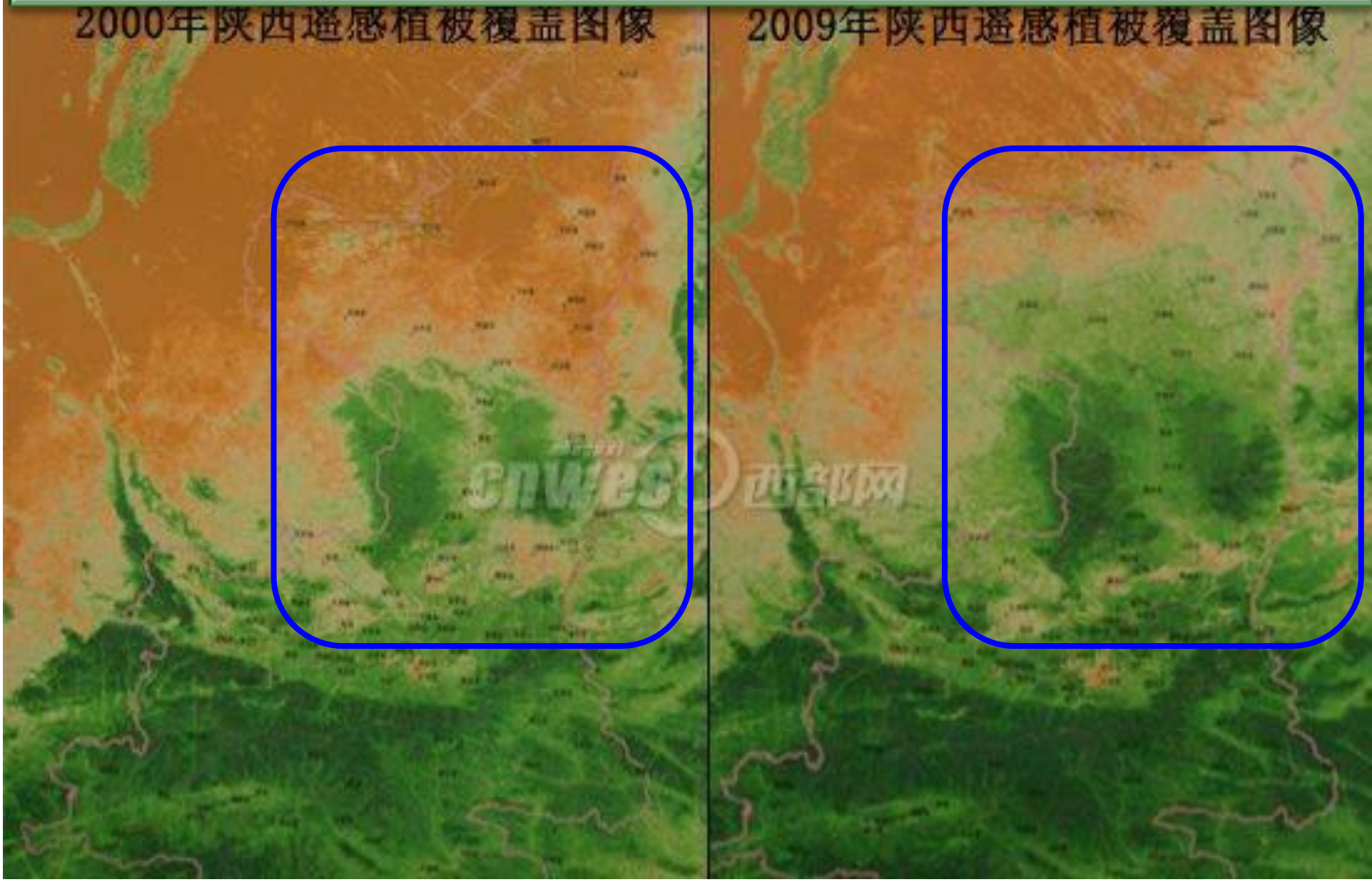
Progresses（进展）

- To the end of 2013, about 15 million ha of slope farmland has been conversed into forest/grassland
- 17.5 million ha of barren mountains and hills were planted trees/grass. Forest and grass cover increased by about 4.5% for the whole China.

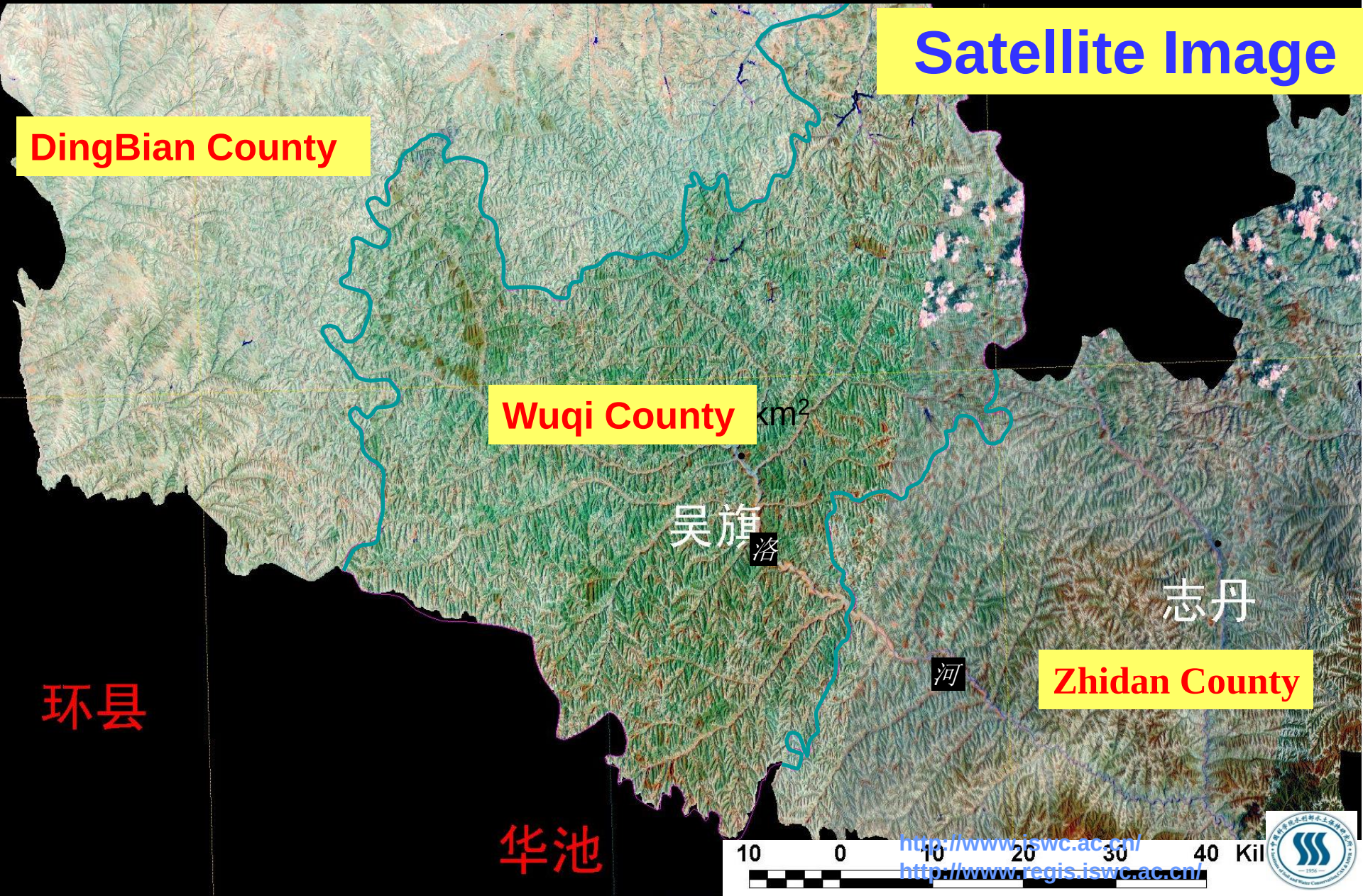


After 10 yr of implementing GGP, vegetation area increased, toward to north 400 km

退耕还林实施10年后，陕西北部绿色植被覆盖区域北界向北扩展了将近400公里



吴起县全县坡耕地1999-2000年全部退耕，从卫星照片看，植被恢复明显，与周围县的植被变化界线与行政分界线相一致



Comparison before and after the GGP in Xingguo county， Jiangxi province 江西兴国

Vegetation cover increases from 28.8% in 1982 to 72.2% in 2009

Comparison before and after implementing the program in Pianguan county，Shanxi province （山西偏关）

Before control

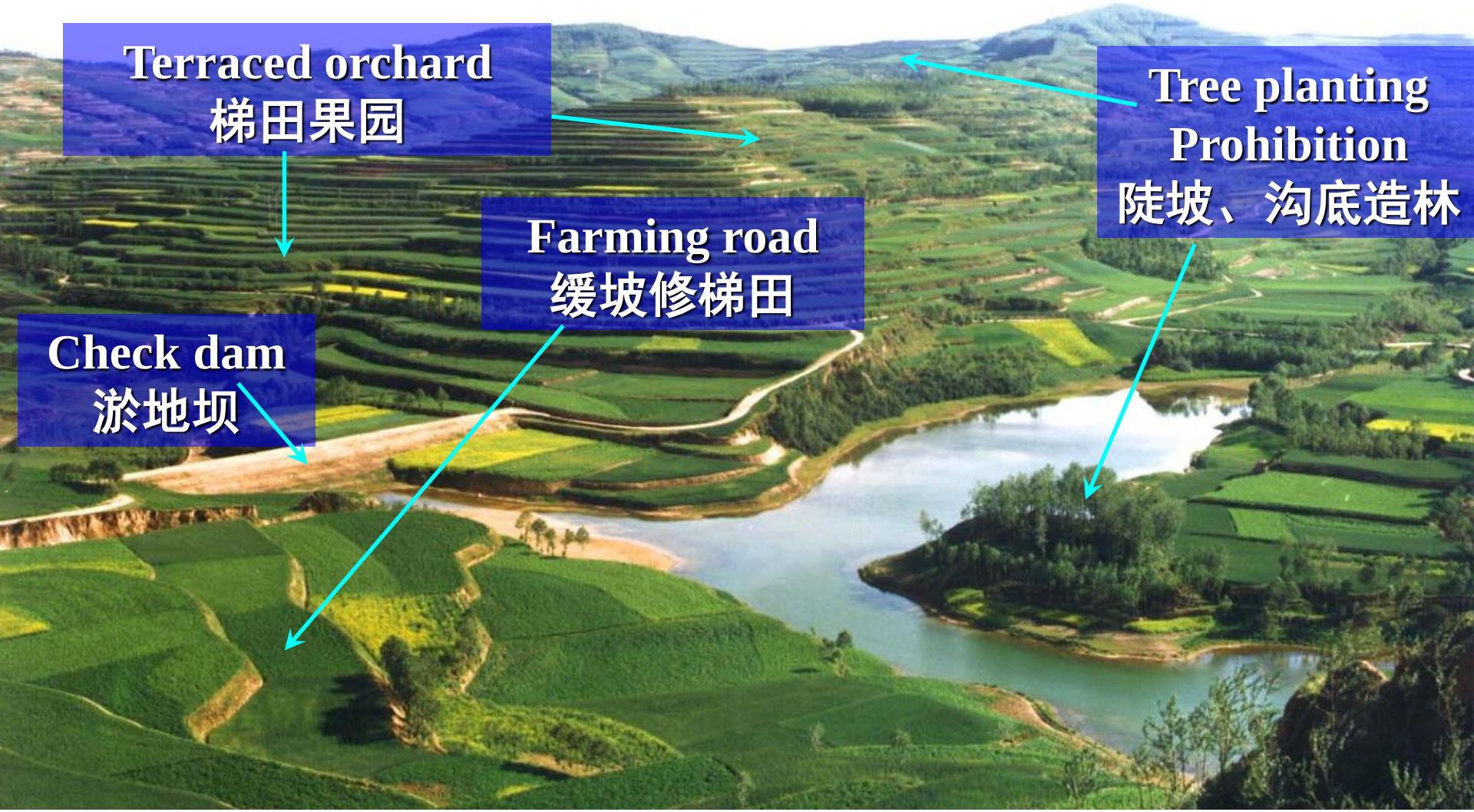
After control

Landscape change after 10 years grazing prohibition in Wuqi County, the Loess Plateau （陕西吴起县）

陕北安塞侯家沟植被变化对比

Integrated SWC model of watershed in Loess Plateau

黄土高原小流域水土保持综合配置模式



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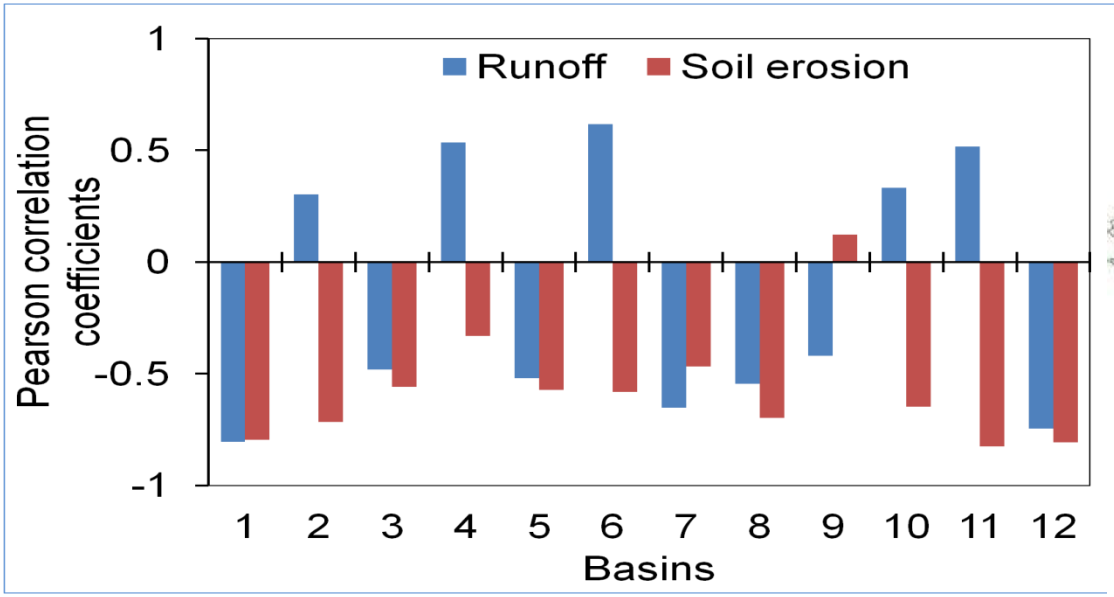
The runoff decreased and the soil erosion significantly decreased, comparing 2003–2007 and 1998–2002, runoff and soil erosion were reduced by 18% and 45.4%, respectively.

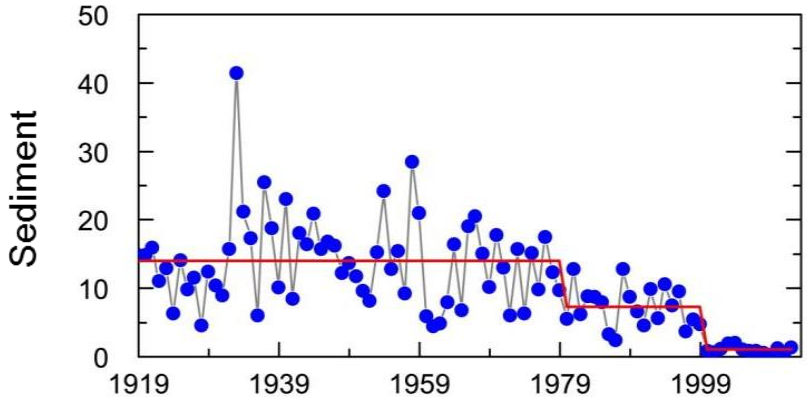


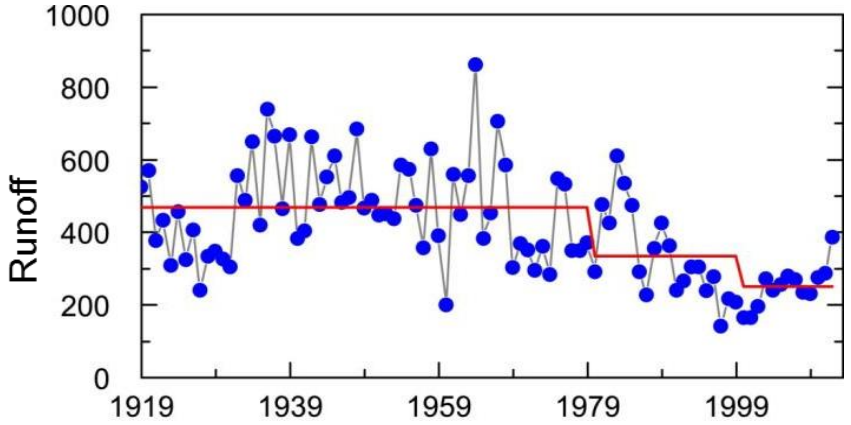
全国11条流域的水喝沙状况

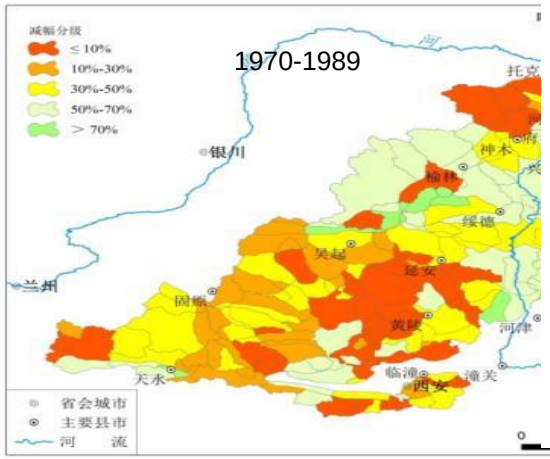
Correlation coefficients of the annual runoff and soil erosion of 11 major river basins

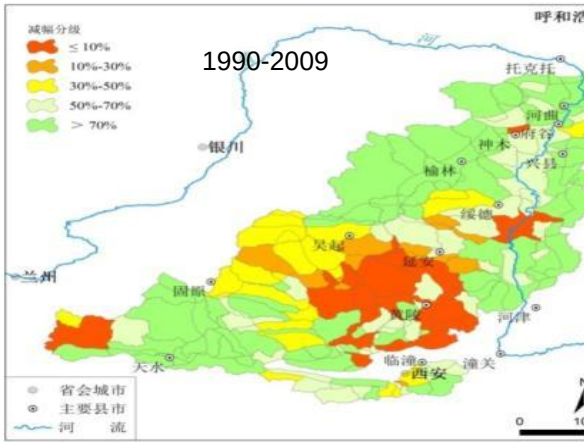
Sediment load decreased in Yellow river

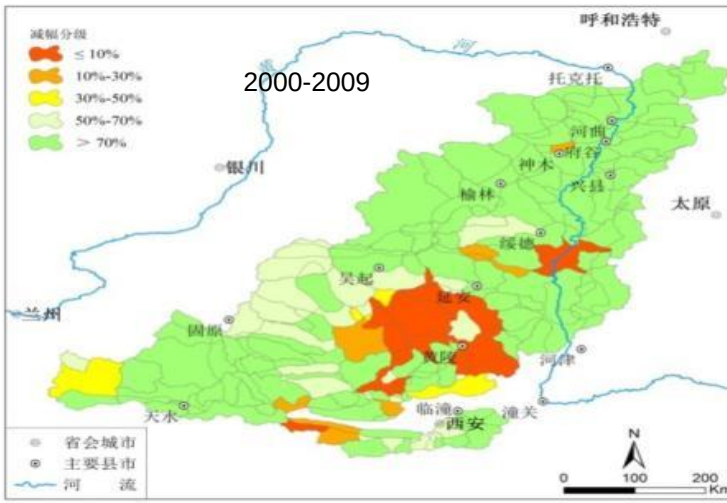
黄河流域、黄土高原的水沙变化状况







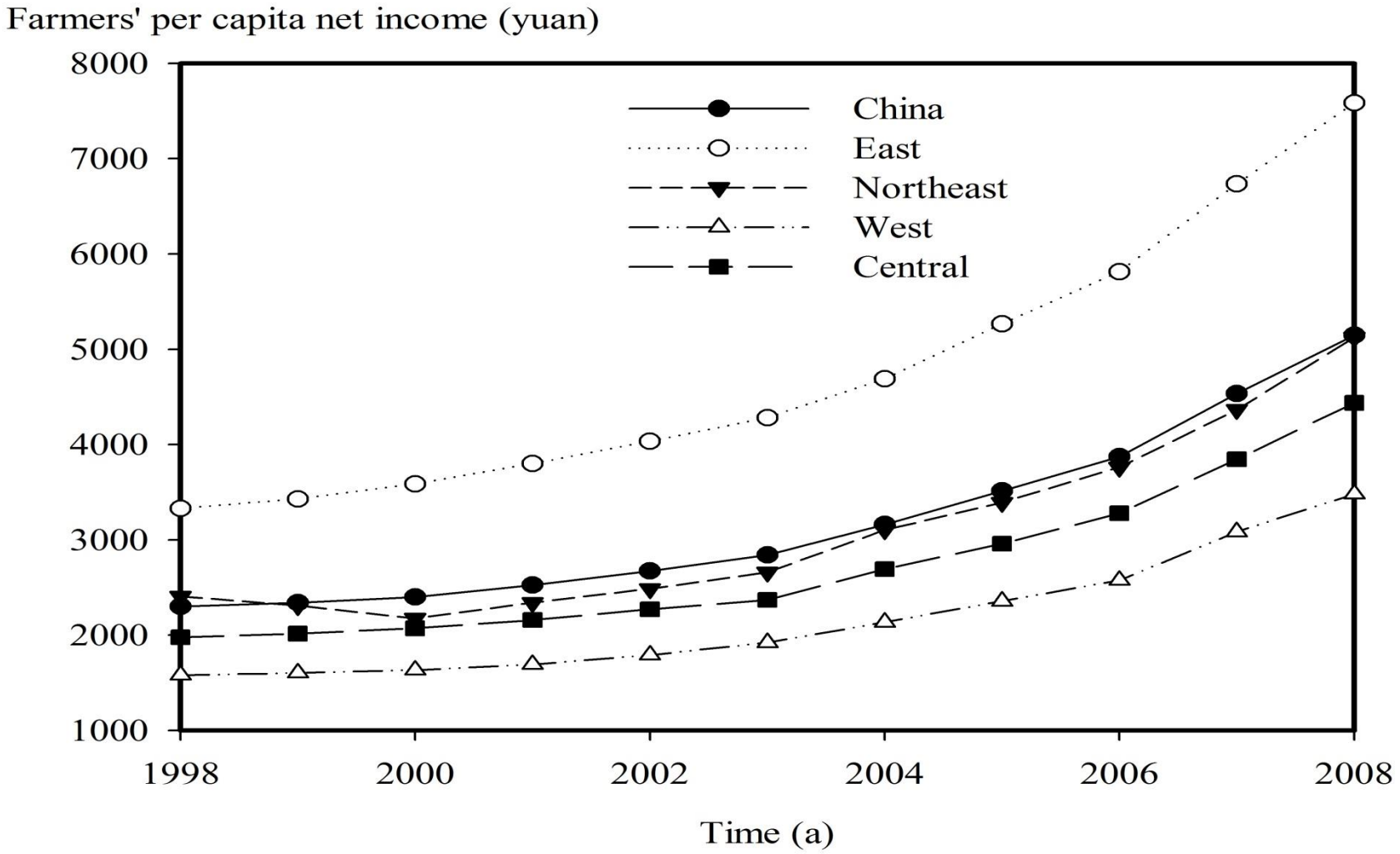




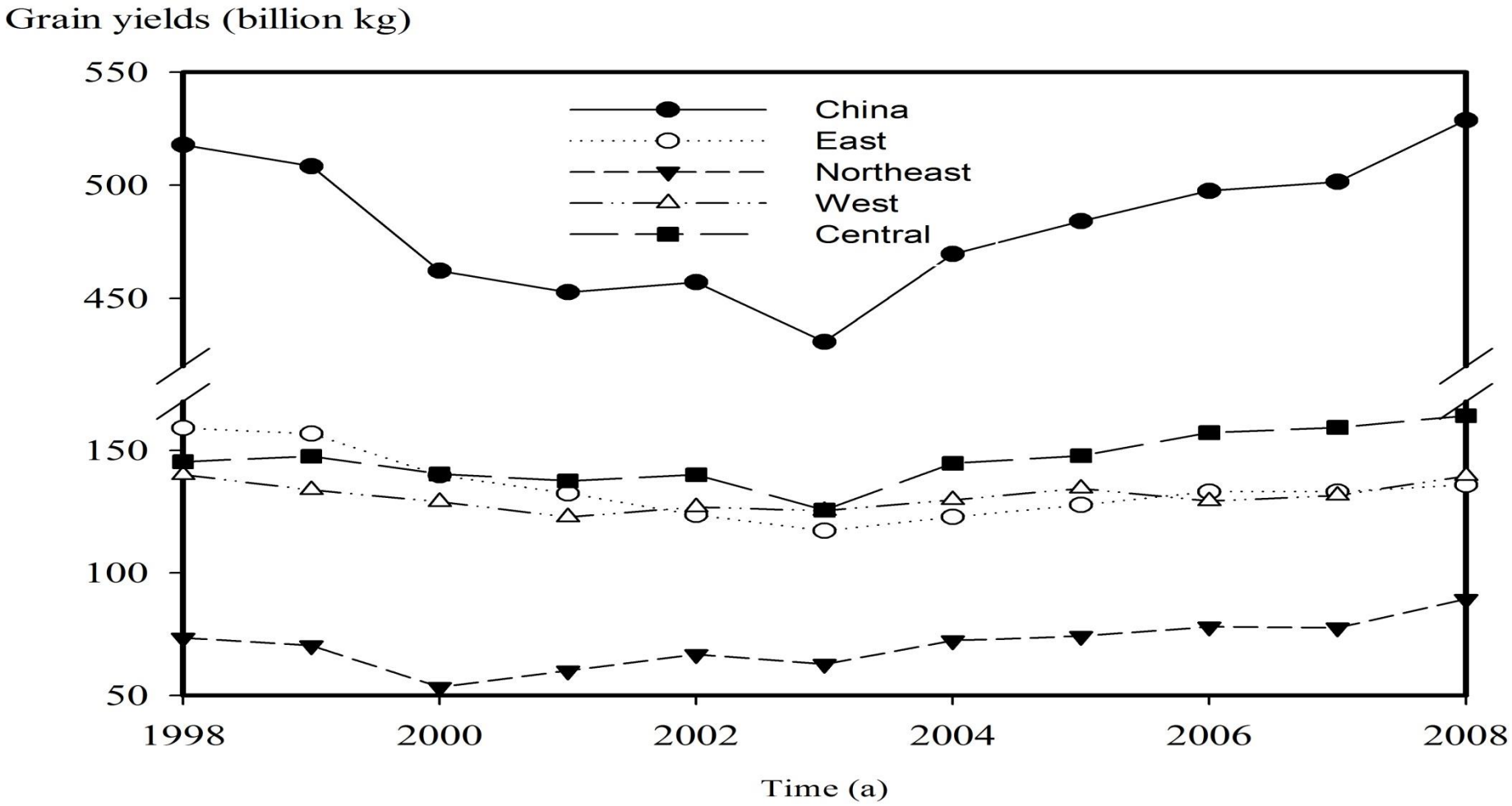
大雨过后，坡耕地（左侧）水土流失依然严重，退耕还林（草）地水土流失明显减轻

In July 2012, large rainstorm occurred on the loess plateau. The rain intensity was out of the historical records. Soil erosion on the conversed land (on the left) are much lower than cultivated land (on the right).

Changes of annual farmers' per capital net income from 1998 to 2008 农民年平均纯收入变化



Changes of annual Grain yields of China and its four major zones from 1998 to 2008 全国年平均粮食总产量变化



Assessment of ecological benefits生态效应评价

To select 6 provinces as the examples to evaluate the ecological benefits of GGP based on observed data

Following data are from the Report of GGP Ecological Benefits Evaluation, 2014. SFA.

Ecological benefits of 6 example Provinces (6 试验省生态效益）

Water conservation（保水）	18.3 billion m^3 /year
Soil Conservation（保土）	0.2 billion ton/year
C-fixed （固碳）	13.97 million ton/year
O_2-released（释氧）	32.15 million ton/year
Absorb pollutants （吸污）	1 million ton/year
Dust retention （滞尘）	140 million ton/year
Substance of wood Accumulation （木材积蓄）	0.4 million ton/year

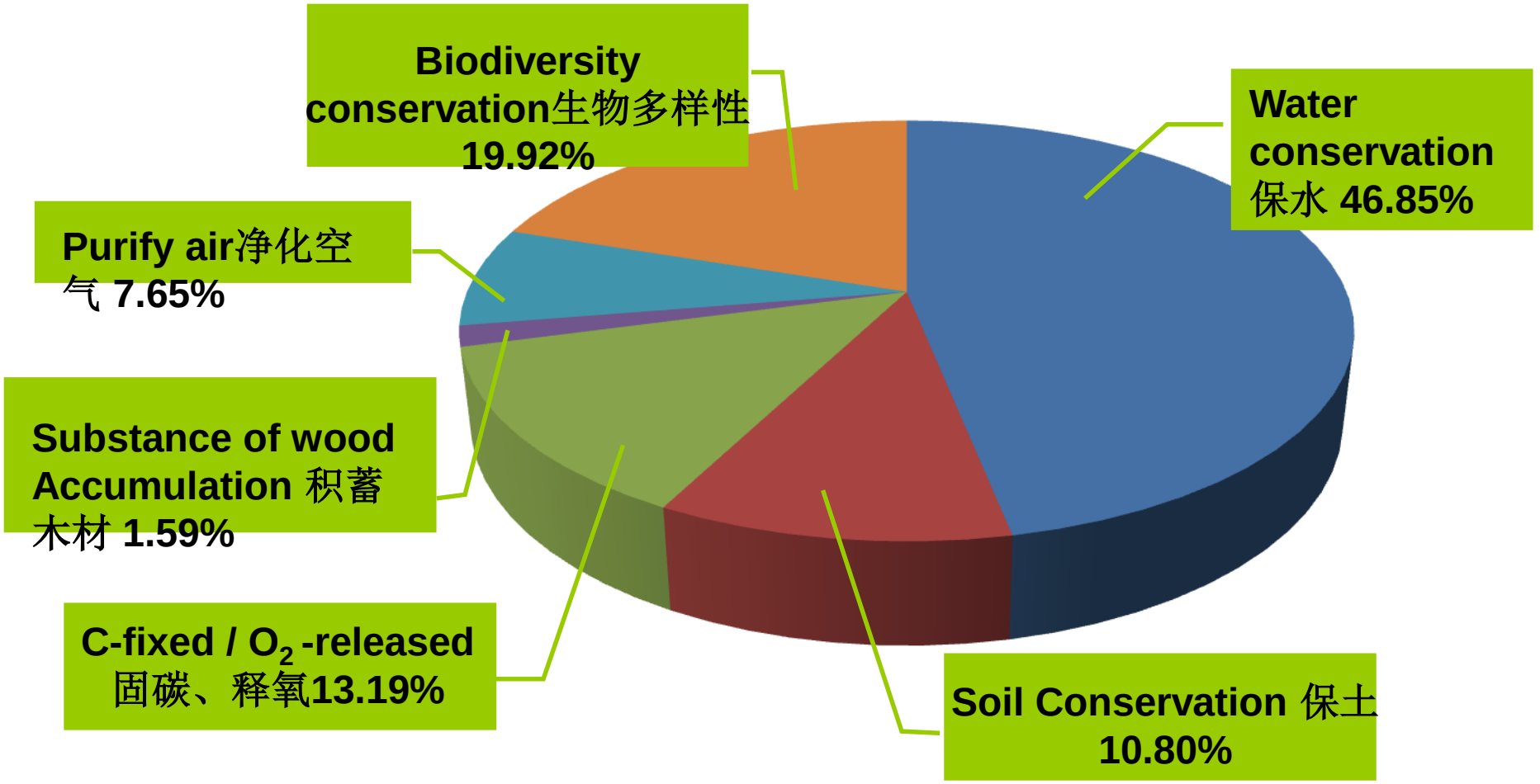
Data from The Report of GGP Evaluation of Ecological Benefits. SFA

Average Annual GGP Ecological Benefits: 6 Provinces (in 10^9 RMB) 生态效益价值计算

Provinces	Water conservation	Soil Conservation	C-fixed / O_2-released	Substance of wood Accumulation	Purify air	Biodiversity conservation	Total
Hebei	565.78	41.10	157.76	31.28	65.16	109.72	970.80
Liaoning	132.03	88.02	92.56	14.54	35.31	129.39	49194
Hubei	241.39	34.53	111.17	6.92	49.55	110.26	553.82
Hunan	443.58	43.46	12.52	0.66	82.62	314.56	897.40
Yunnan	350.30	79.65	111.66	8.09	47.62	142.17	739.49
Gansu	376.40	199.33	107.89	10.31	64.42	90.59	848.94
Summary	2109.48	486.09	593.65	71.80	344.68	896.69	4502.39

Data from The Report of GGP Evaluation of Ecological Benefits. SFA

Ecological benefits 生态效益比例



Ecological Benefits from GGP in Example Provinces

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Impacts

Climate（气候）-- Dry ? or Wet ? Hot?or Cold?

Soil（土壤）---- Rich? Or Poor? Dry or wet?

Soil erosion（侵蚀） ---- Positive ? (Mechanism/ process)

Water（水）---- Runoff (more or less?) Quality?

And other impacts on environment ???

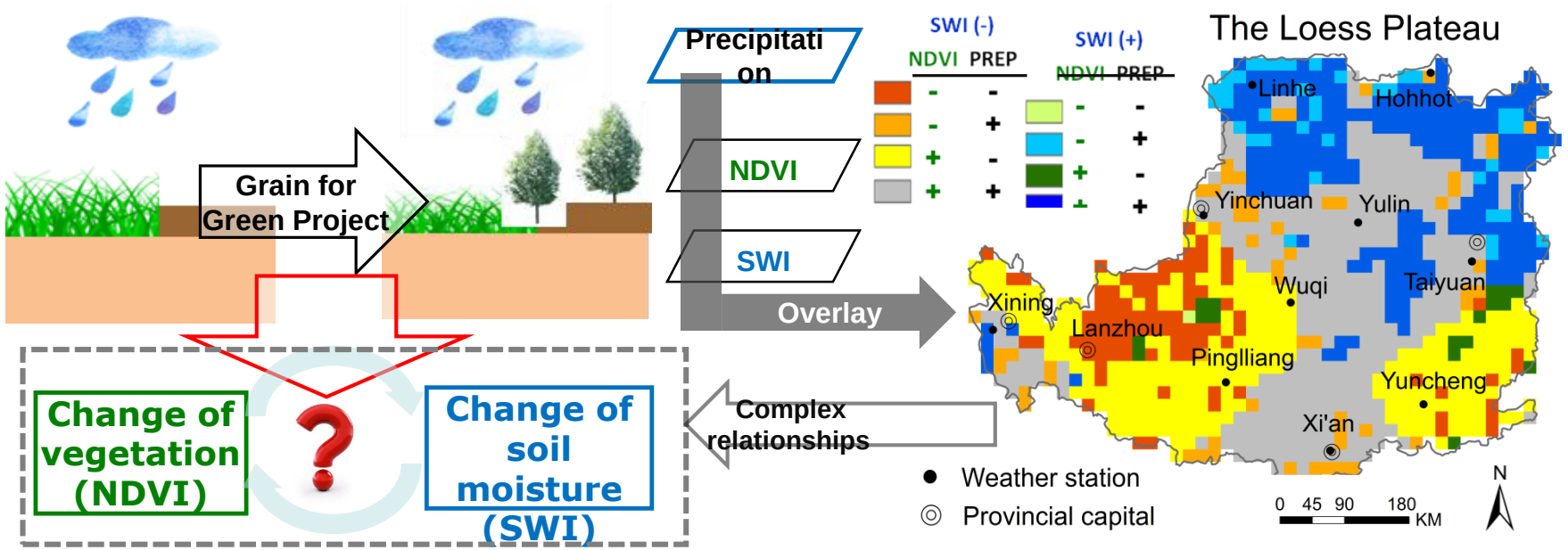
There are different Viewpoints with the impacts of re-vegetation in Arid and semi-arid Areas

One tree is a Water Pump
（一棵树是一部抽水机)

Forest is reservoir of conserving Water
(森林是水库--涵养水源）

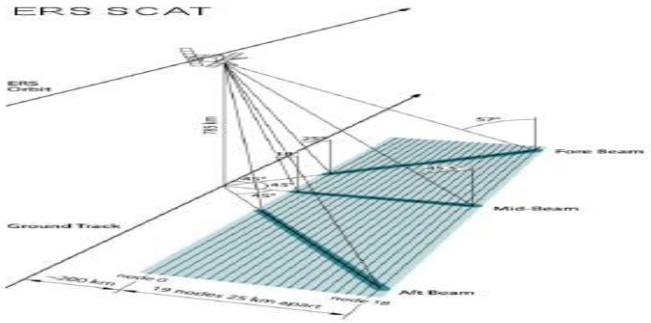
- **The soil moisture is very important for arid and semi-arid region such as the Loess Plateau. It is necessary to know the changes of soil moisture after re-vegitation at big scale after GGP implement.**
- **There are many factors to influence soil moisture. In this study we only paid more attention to the relationship between changes of vegetation distribution and soil moisture using the remote sensing and ground observation data.**

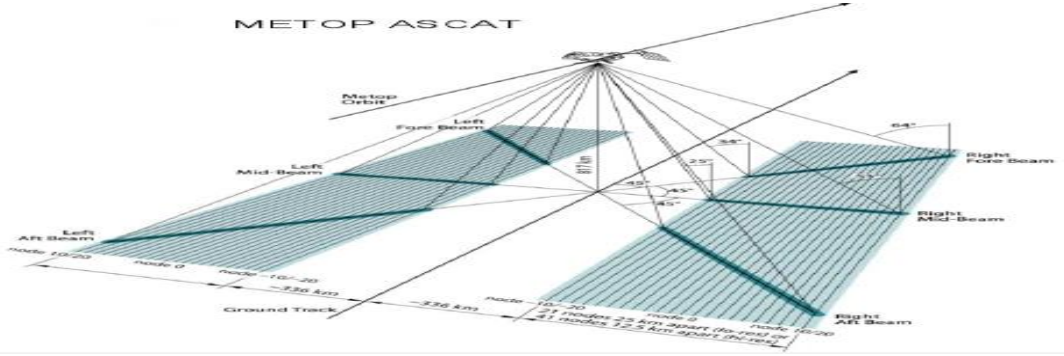
To inspect the relationship between re-vegetation and surface soil moisture



Data 1 (Soil Moisture Index)

Soil Moisture Index (SWI) was estimated based on the back-scatter coefficient produced by the European Remote Sensing Satellite (ERS-1/2) and Meteorological Operational satellite program (MetOp). The spatial resolution of ASCAT soil moisture data was 25 km, and temporal resolution was less than 3 days. The SWI was derived from the surface soil moisture data using a two-layer water model, representing the soil moisture content in the 1-metre layer of top soil.





Data 2, Vegetation (NDVI) data

The NDVI time series were produced by the vegetation sensor (SPOT VGT) carried on the SPOT satellite. The SPOT VGT data were ten day maximum value NDVI synthesis products (VGT-S10) with a 1 km resolution. They were provided by the Cold and Arid Regions Sciences Data Center at Lanzhou (http://westdc.westgis.ac.cn) and VEGETATION processing Centre (CTIV) (http://www.spot-vegetation.com/).

Data 3 Field Soil water Observation data

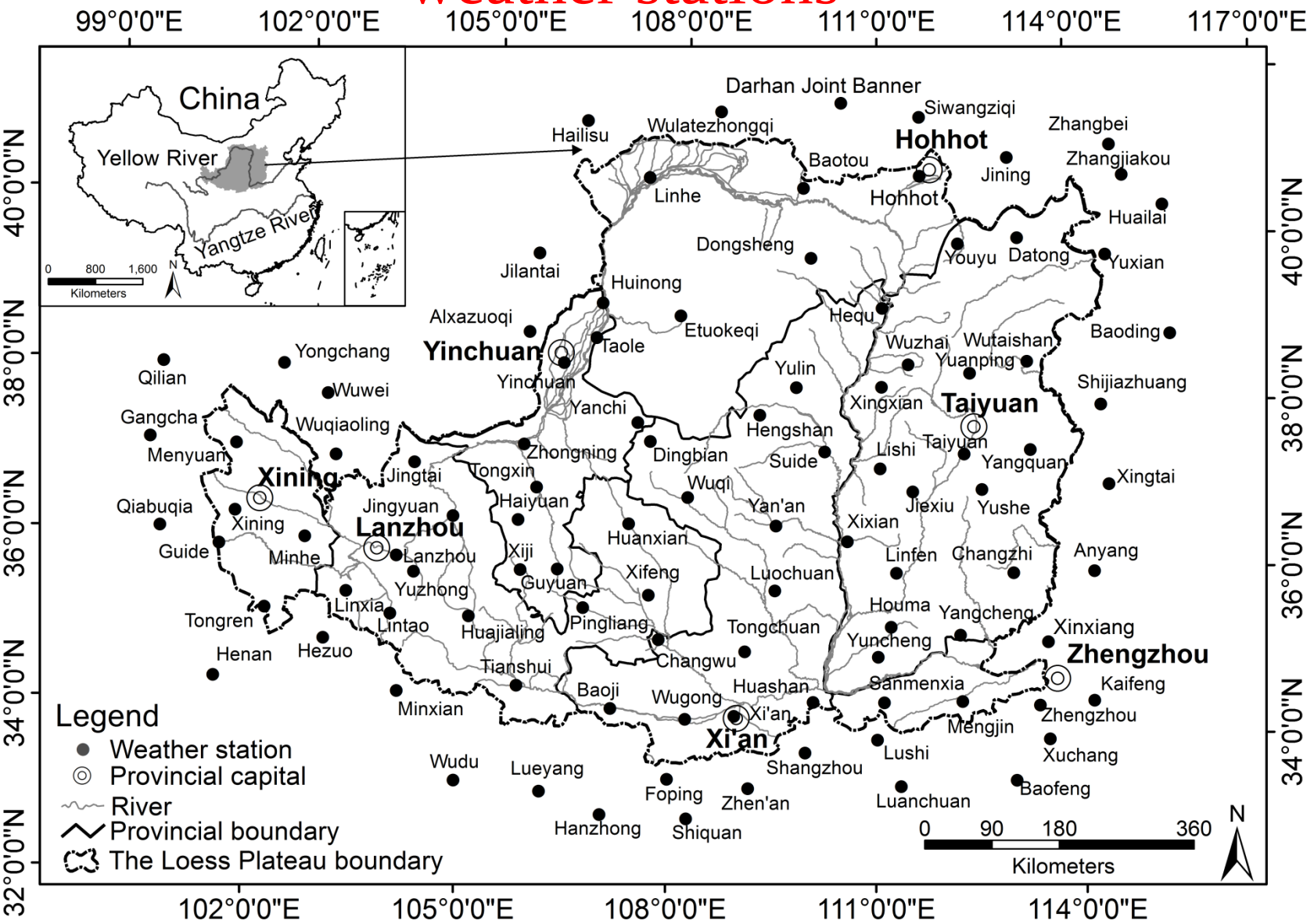
The field observated soil water data were collected from 118 agricultural Meteorological field stations （http://cdc.cma.gov.cn/）, including soil moisture at 0~10 cm，10~20 cm，40~50 cm，60~70 cm，and 90~100 cm lays。

Data 4, Precipitation data

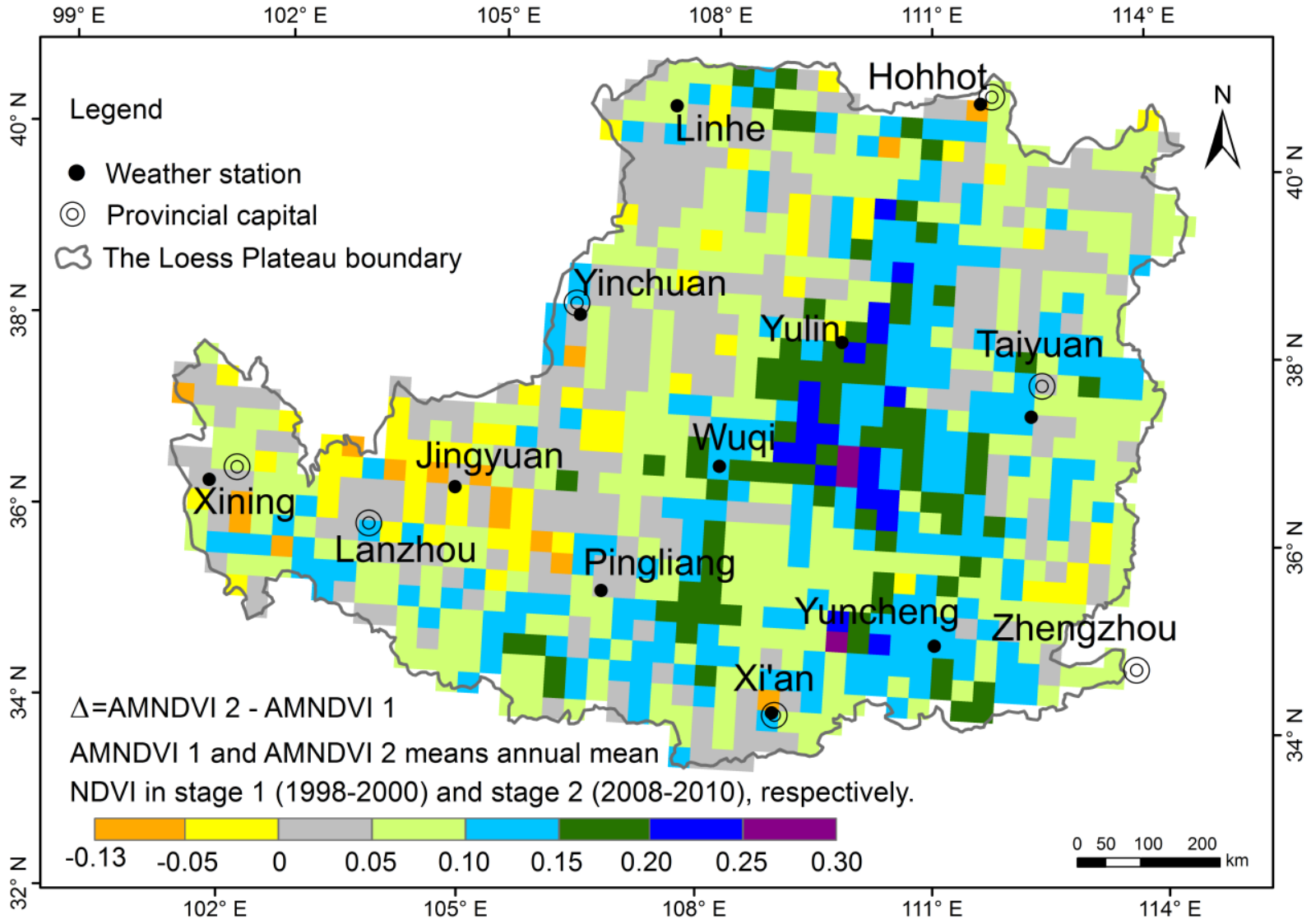
The monthly precipitation data of 101 weather stations within or nearby the Loess Plateau were provided by the China Precipitation Administration National Precipitation Information Center (http://cdc.cma.gov.cn/home.do).

All data collected include 2 separate periods, which are 1998-2000 (before GGP) and 2008-2010(after GGP).

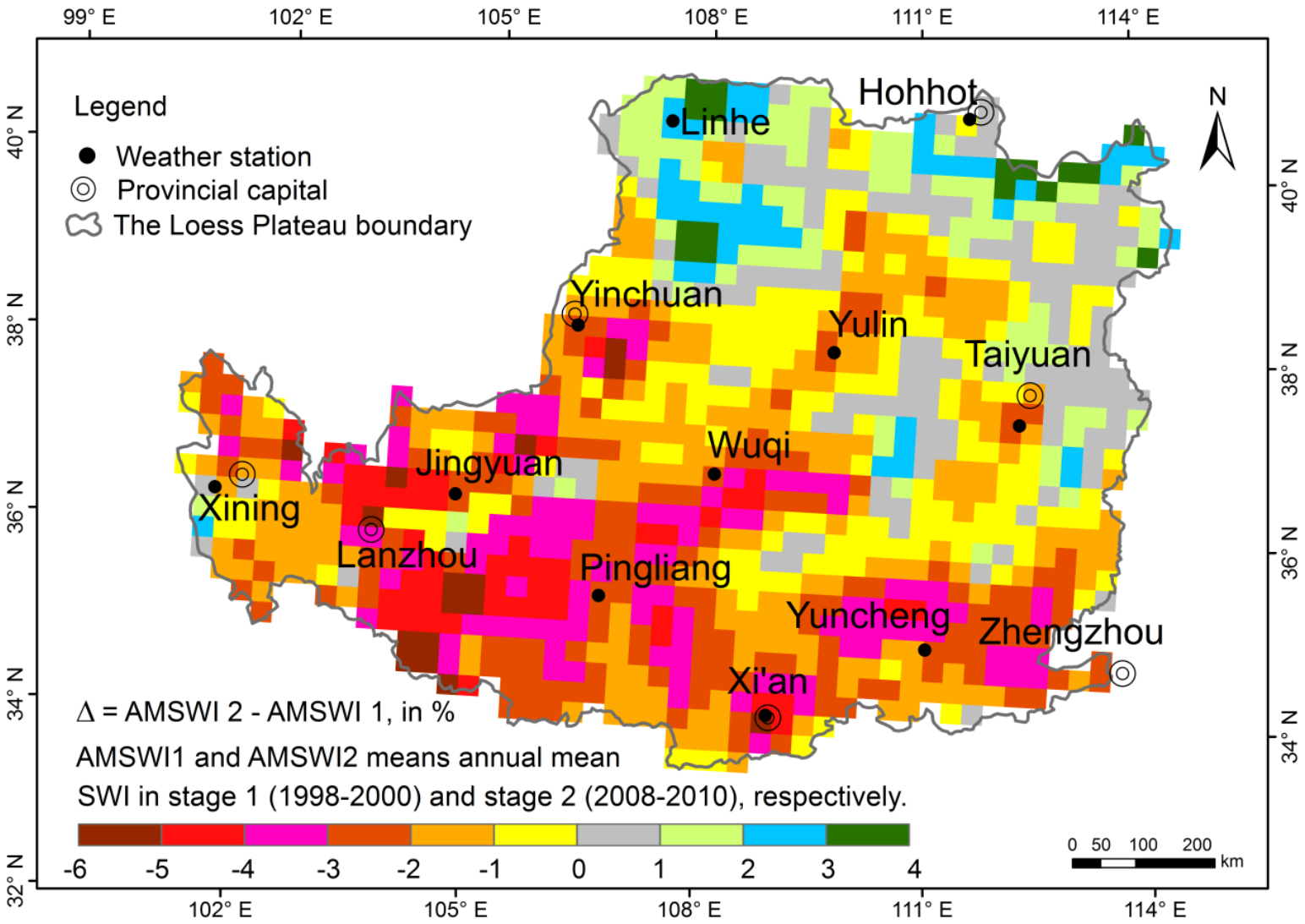
Location of the study site and distribution of weather stations



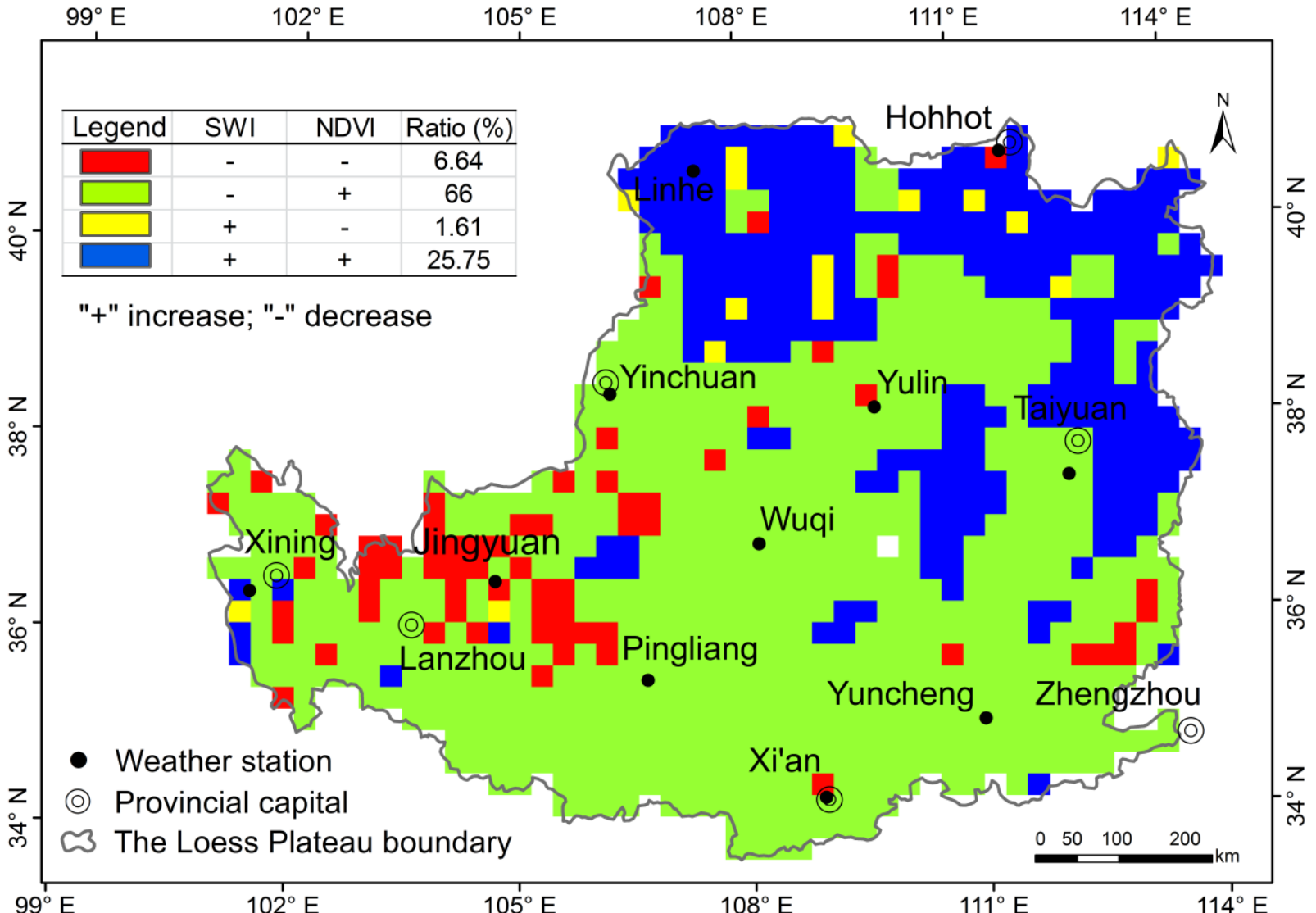
The spatial differences in NDVI in 2 stages on the Loess Plateau（退耕还林前后绿度指数变化趋势空间差异）



The spatial differences in SWI in 2 stages on the Loess Plateau（退耕还林前后土壤湿度指数变化趋势空间差异）



The spatial variation in the proportion of area between the SWI and NDVI（退耕还林前后土壤湿度指数和绿度指数变化趋势比较的空间差异)



High density or non-suitable re-vegetation caused some impacts on water resources, such as runoff and soil moisture decreased, plant in lower productivity, even died

Conclusion

These results indicate that re-vegetation, and climate changes have impacts on soil moisture. However, re-vegetation may be the major factor for soil moisture decreasing in most areas of the Loess Plateau. It is, therefore, suggested that soil moisture should be kept in mind when carrying out re-vegetation in arid and semi-arid regions.

Summary（总结）

Functions作用

The GGP, as a large-scale ecological restoration project, has achieved remarkable benefits on both aspects of ecology and economy
明显

Inspirations启示

It is important to have 4 combinations
1. government and farmer participation;
2. compensation policy and Technology
3.ecological benefit and economical income;
4. short-term and long-term . 多元结合

Challengers挑战

How to maintain sustainability?
How to meet the more needs of farmer, such as income, food, education, culture, and others?
可持续性

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