The Linkages among Climate Change, Drought, Desertification and Biodiversity Loss

LD in Asia and LDC/SLM in Western China

Capacity-building workshop for Central, South and East Asia on ecosystem conservation and restoration to support achievement of the Aichi Biodiversity Targets
July 13-19, 2014, Jeju Island, R.Korea

Prof. ZHANG, Kebin
College of Soil and Water Conservation
Beijing Forestry University, Beijing, China
Email: ctccd@bjfu.edu.cn

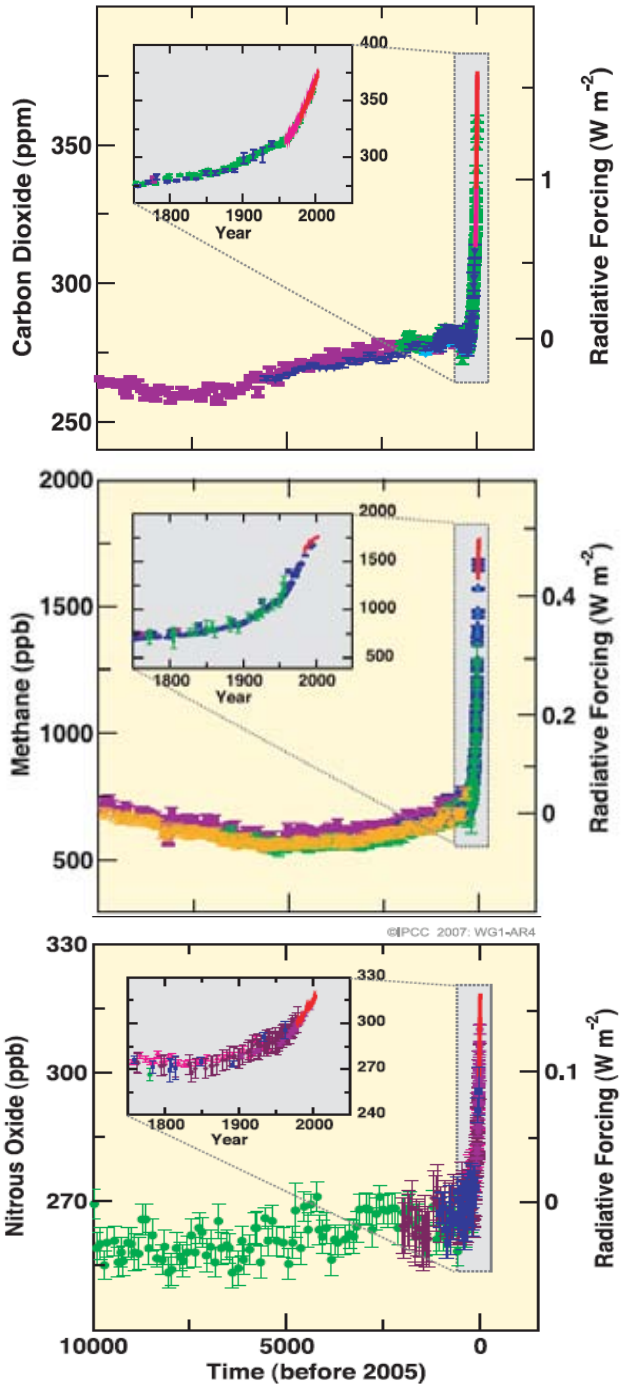
16th Session of UN CSD, May 8, 2008, New York, USA

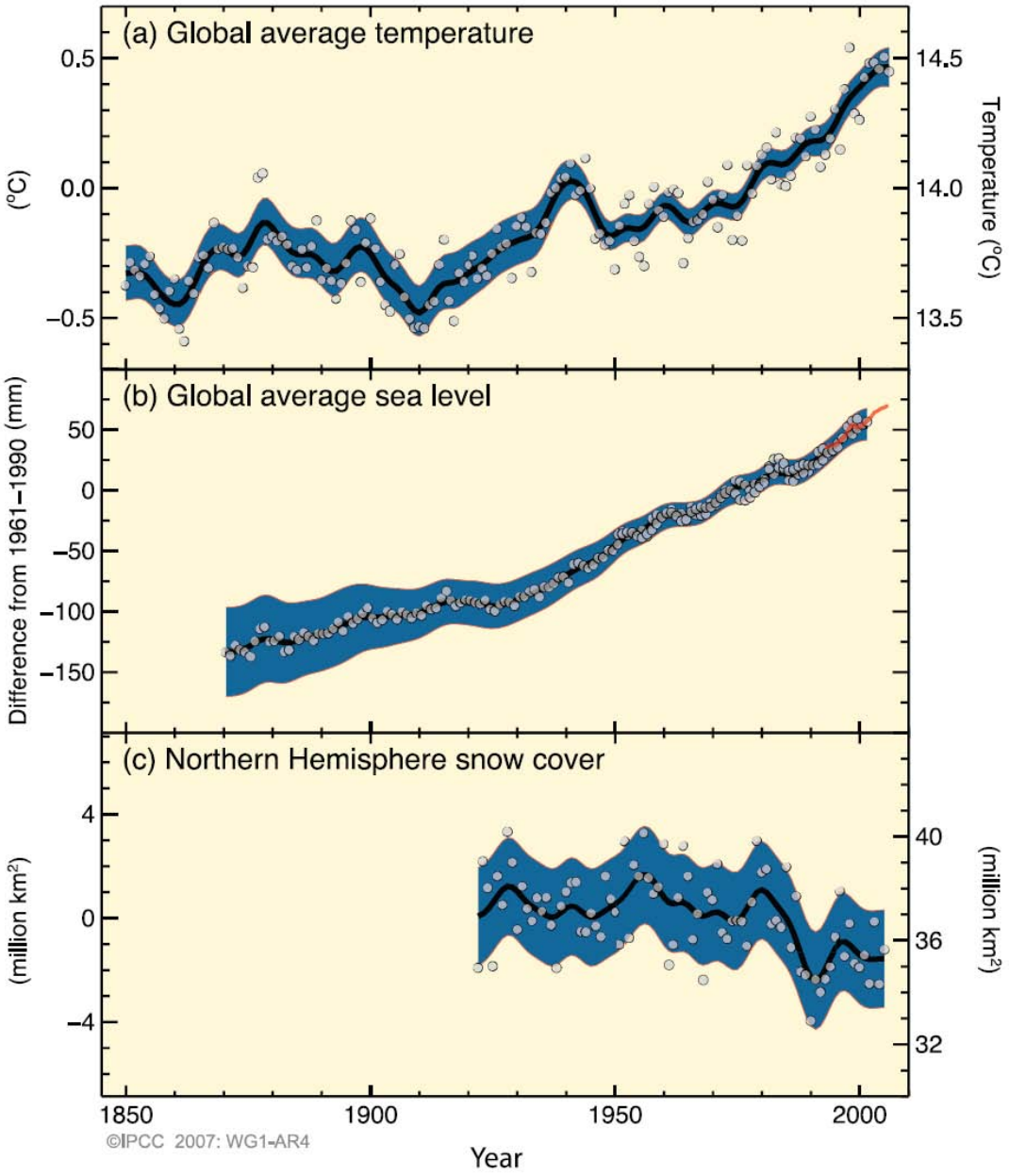
Part I

The Linkages among Climate Change, Drought, Desertification and Biodiversity Loss

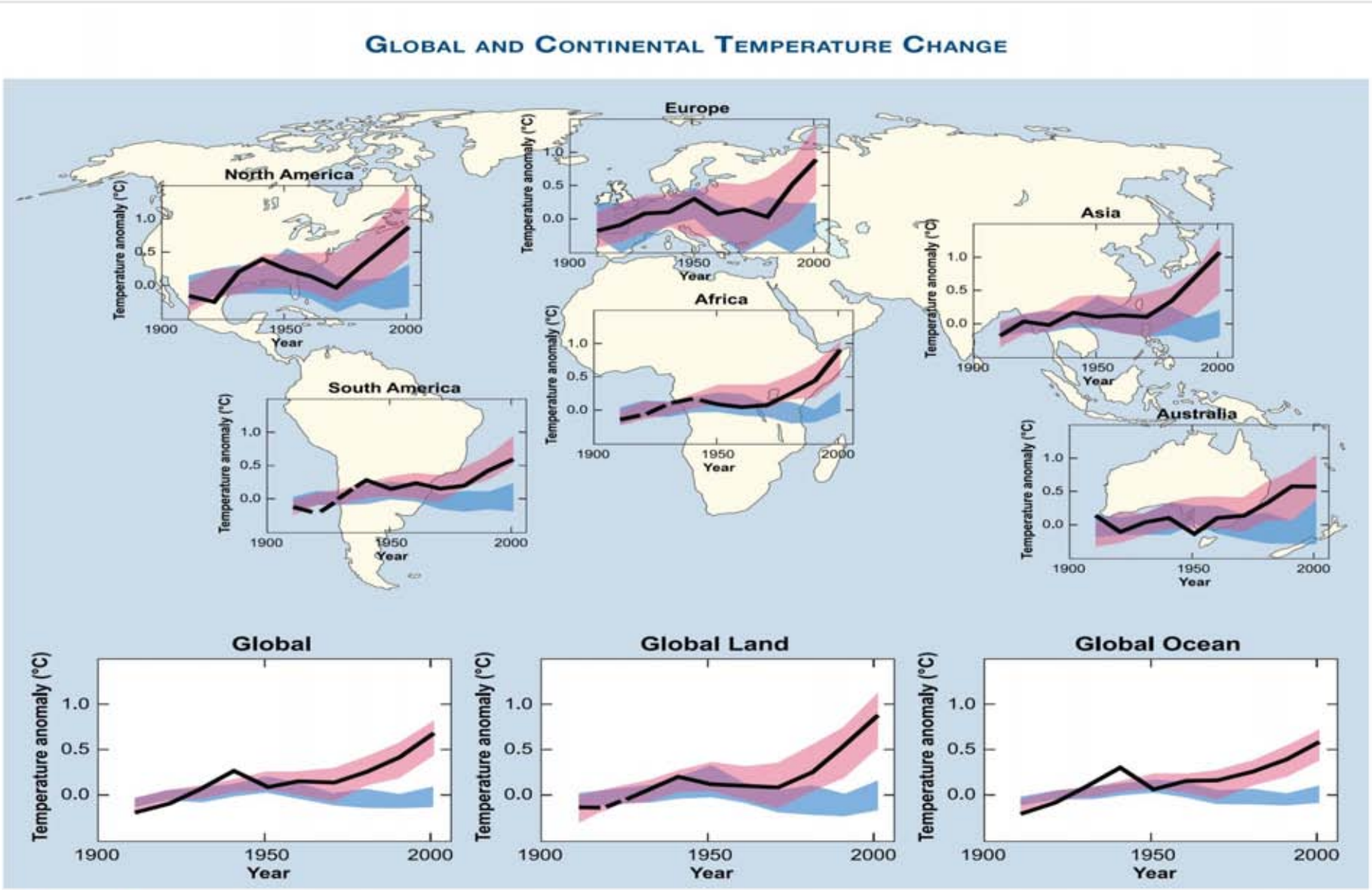
气候变化–干旱–荒漠化–生物多样性损失之间相互关系

The reality of climate change





The reality of climate change



Cause & Impact of Climate Change

Climate is mainly determined by:

- **Sun Radiation:**
- **Atmosphere Current:**
- **Ground Cover (albedo/radiation rate from earth):**

Any changes in above three components will lead to **Climate Change**

Causes of Climate Change

- **Greenhouse gases**
- El Niño and La Niña
- Plate tectonics
- Solar variation
- Orbital variation
- Volcanism
- **Fossil fuels**
- **Aerosols (dust storm)**
- **Cement manufacture**
- **Land use** (Changes in **albedo**)
- **Livestock**

Impacts of Climate Change

Increase in extreme events:

drought, flood and fire;

- Decrease productivities:
- Increase poverty and lead to unease of society (refugee and even war):
- Life
- Loss of biodiversity

Causes of Drought

Most of drought is caused by Climate Changes

Atmosphere current: Above average prevalence of high pressure systems;

Winds carrying continental, rather than oceanic air masses (ie. reduced water content)

El Nino (and other oceanic temperature cycles)

Deforestation (land cover changes)

Climate change has a substantial impact on agriculture throughout the world, and especially in developing nations.

Impacts of Drought

The consequences of drought may include:

Decrease productivities;
Increase hunger and poverty;
Aggravation desertification & Dust storms;
Increase thirst, famine by water shortage;
Increase disease;
Aggravation wildfires;
Aggravation social conflict and war;
Lead migration or relocation;

Silence Killer

Causes of LD/Desertification

Land Degradation/desertification have been caused by **natural factors** and **human factors** as well as affected by **global climate change.**

Overexploitation of natural resources (cultivation of farmland, over-grazing, fuel wood collection and deforestation, excessive use of water resources in dryland region (inland regions), etc. are the main causes of human factors in desertification.

Social & economic factors such as huge population pressure, un-developed economic and some un-rational policy are the main factors in desertification.

Global warming also lead desertification enlarged and aggravation and much difficult in combating desertification.

Impacts of LD/desertification

Aggravating the Conflict between Man and Land and Shrinking Human Space for Subsistence;

Increasing the Frequency and Severity of Natural Disasters, Deteriorating the Environment and Impairing the Subsistence Conditions of Humans;

Causing Enormous Economic Loss;

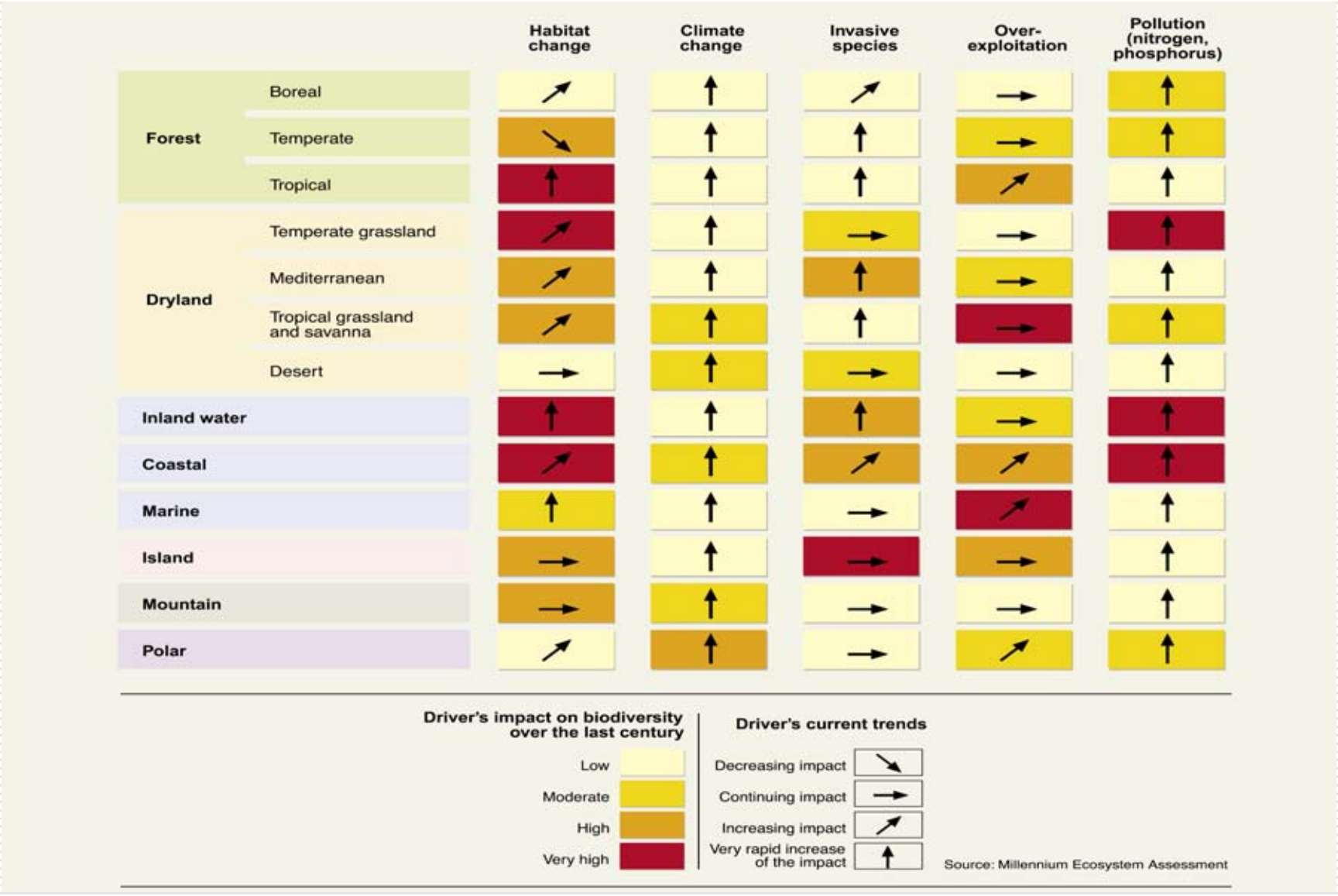
Aggravating Poverty, Increasing Regional Gap and Impairing National Unity and Social Security;

Desertification is a severe eco-system problem threatening the living condition of human being. It is also a tough problem that **restricts economic** development. And at same time, it is a serious social problem that widens **regional gaps** and affects **social stability**, **refugee** even **war.**

Causes of Biodiversity Loss

The most important **direct drivers** of biodiversity loss and change in ecosystem services **are habitat change** - such as land use change, physical modification of rivers or water withdrawal from rivers, loss of coral reefs, and damage to sea floors due to trawling, **climate change**, invasive alien species, **overexploitation** of species, and **pollution.**

Main Direct Drivers of Loss of Biodiversity



Impacts of Loss of Biodiversity

Biodiversity contributes:

Directly (through **provisioning**, **regulating**, and **cultural ecosystem services**) and;

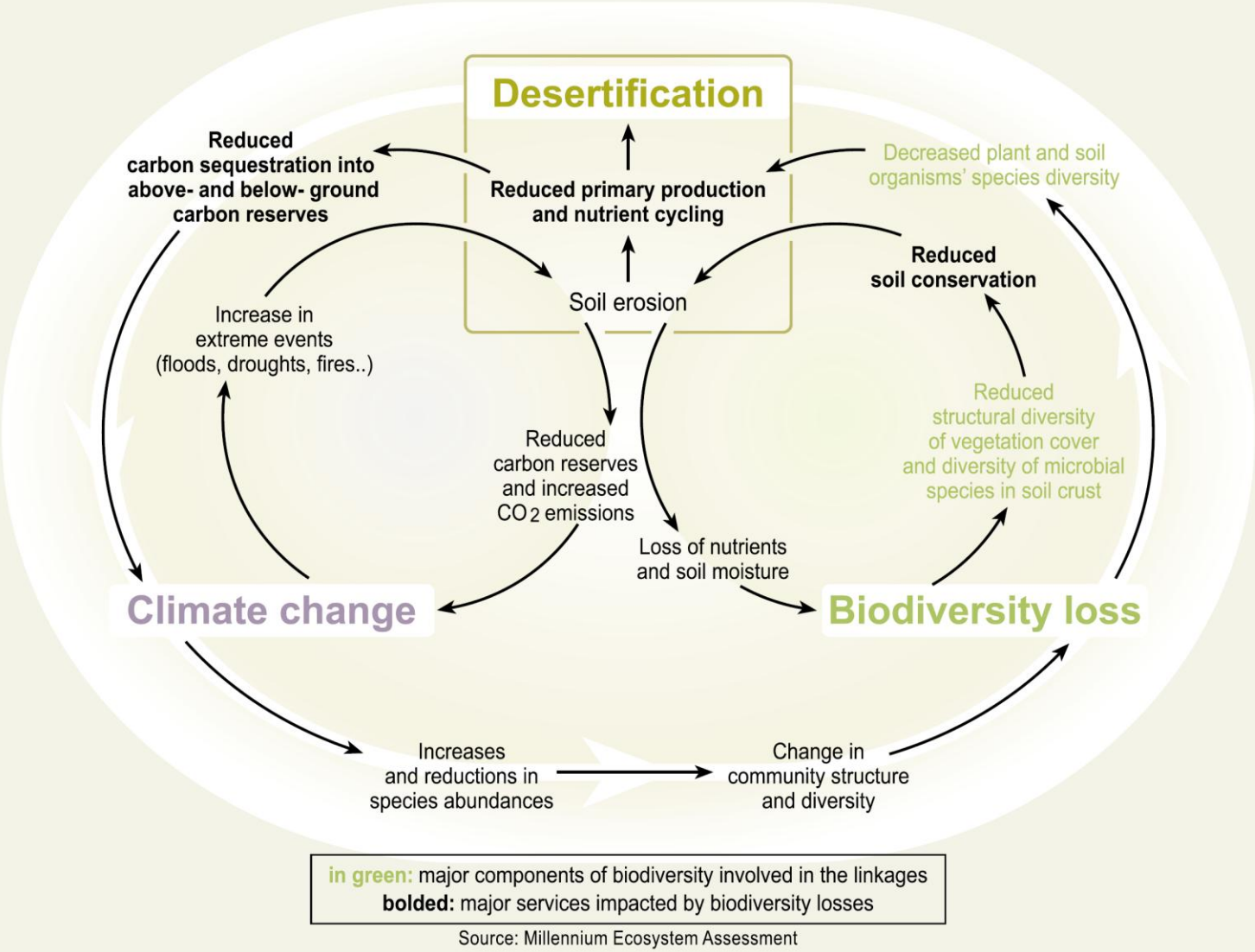
Indirectly (through supporting ecosystem services) to many constituents of human well-being, including security, basic material for a good life, health, good social relations, and freedom of choice and action.

Many people have benefited over the last century from the conversion of natural ecosystems to human-dominated ecosystems and the exploitation of biodiversity.

At the same time, however, these losses in biodiversity and changes in ecosystem services have caused some people to experience **declining well-being**, with **poverty** in some social groups being **exacerbated**.

Changes of land cover (**albedo/radiation**) cause **climate change**

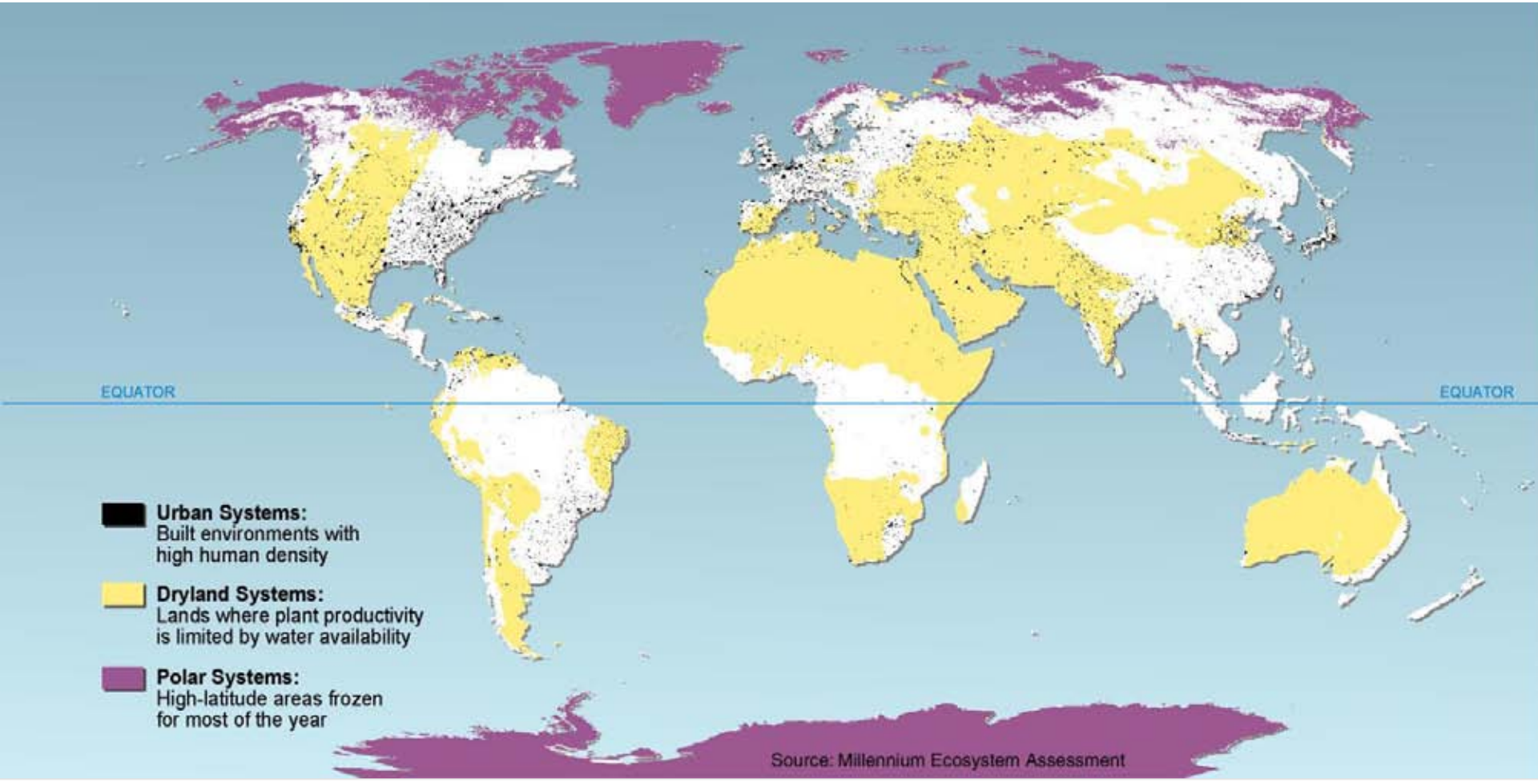
Linkage and feedback loops among **Desertification, Global Climate Change** and **Biodiversity Loss**



Conclusions of Part ONE

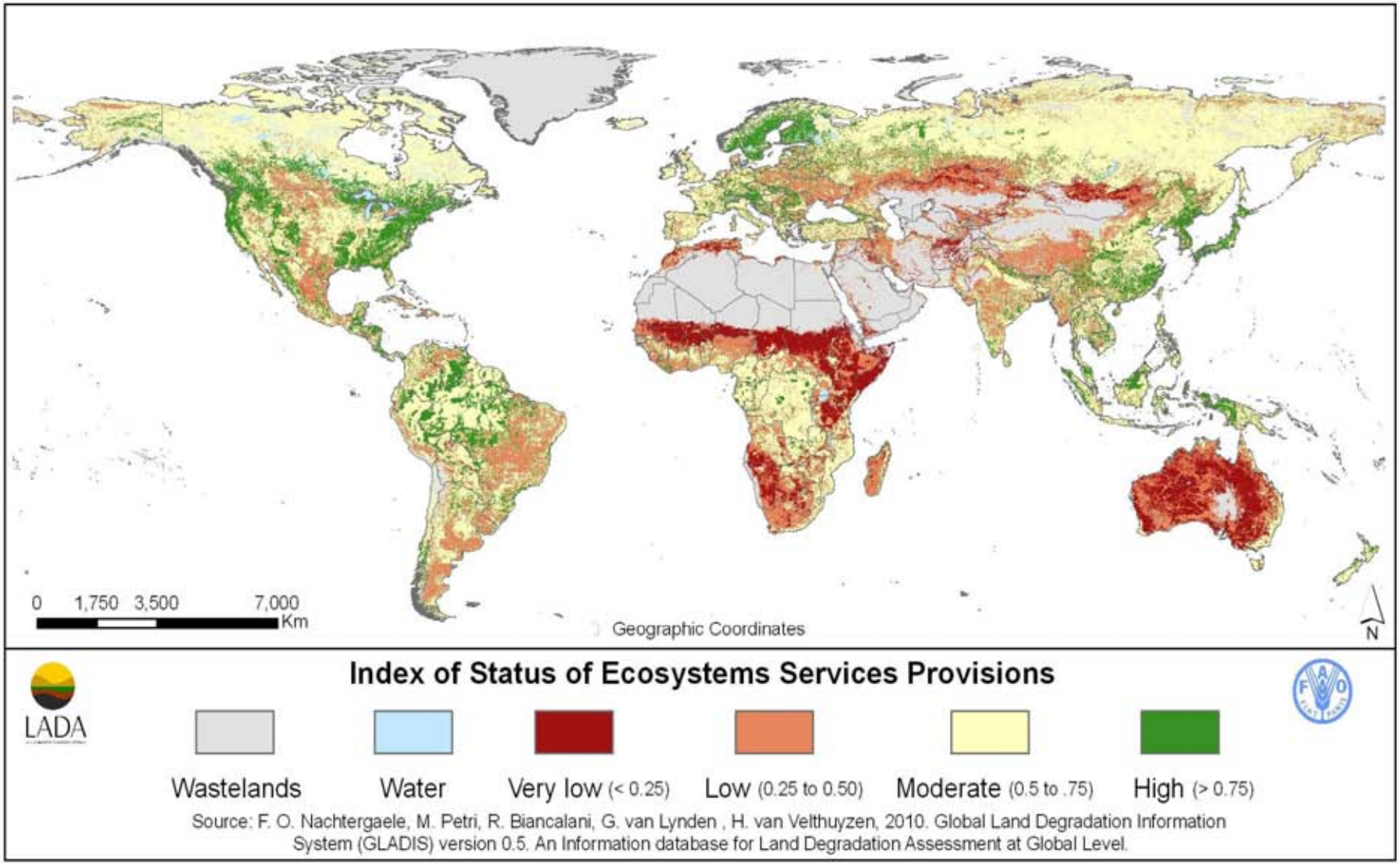
- Climate Change, Drought, Desertification, and Biodiversity Loss are **closely related to each other** (**cause – effect**);
- Human is parts of the Earth, we must respect nature and careful treat the Earth;
- Partnerships and cooperation are needed;
- More research are needed in fields of Climate Change, Drought, Desertification, and Biodiversity Loss and their **linkage** in future;
- Much attentions should pay to the undeveloped regions, and the **poor** at present; and the **Vulnerable Regions**.

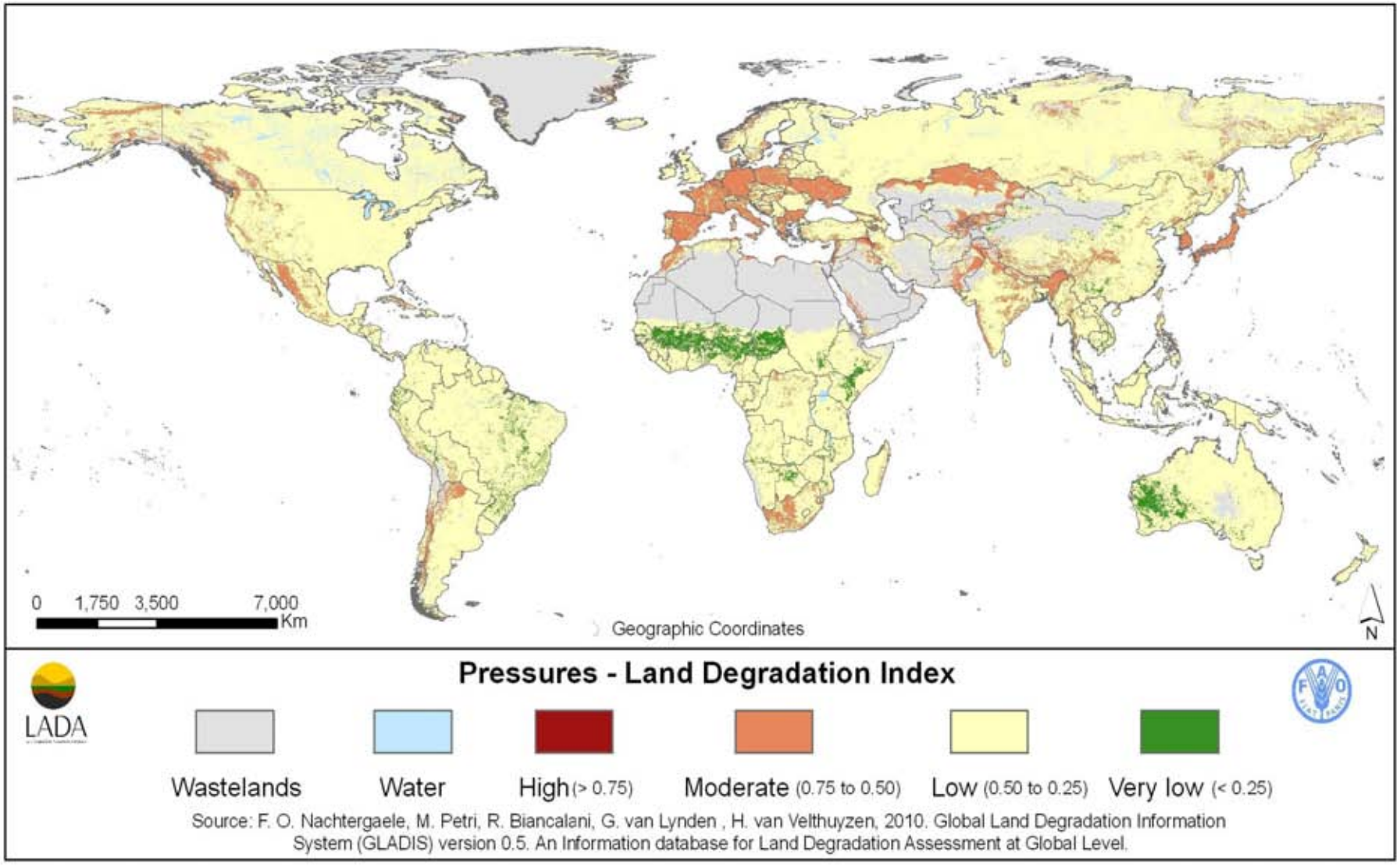
Ecosystem services & poverty reduction

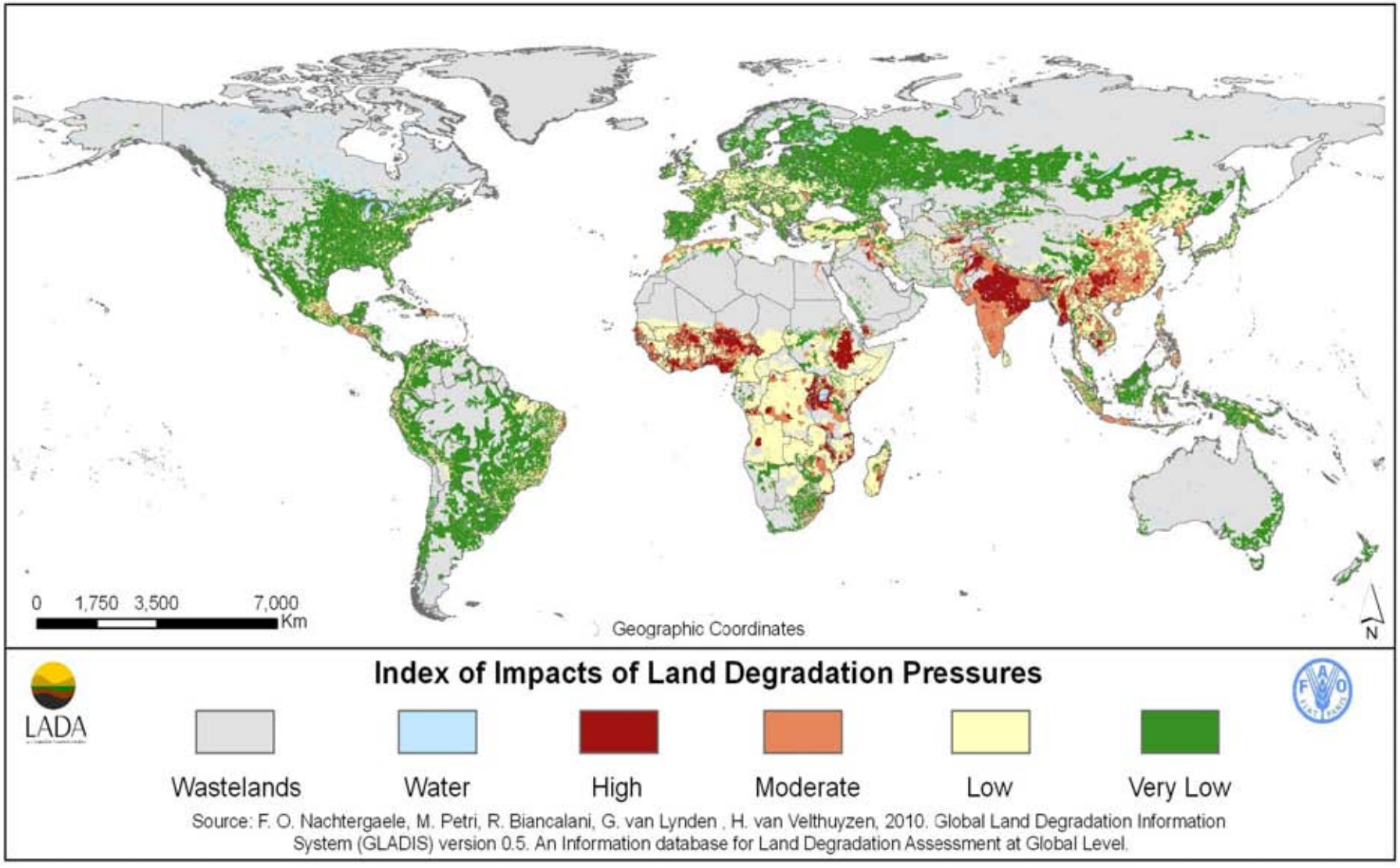


Critical concern: Dryland systems

- Cover 41% of Earth's land surface and more than 2 billion people inhabit them, 90% of whom are in developing countries


0 1,750 3,500 7,000
Km
Geographic Coordinates
N
LADA
Index of Status of Ecosystems Services Provisions
Wastelands
Water
Very low (< 0.25)
Low (0.25 to 0.50)
Moderate (0.5 to .75)
High (> 0.75)
Source: F. O. Nachtergaele, M. Petri, R. Biancalani, G. van Lynden , H. van Velthuyzen, 2010. Global Land Degradation Information System (GLADIS) version 0.5. An Information database for Land Degradation Assessment at Global Level.

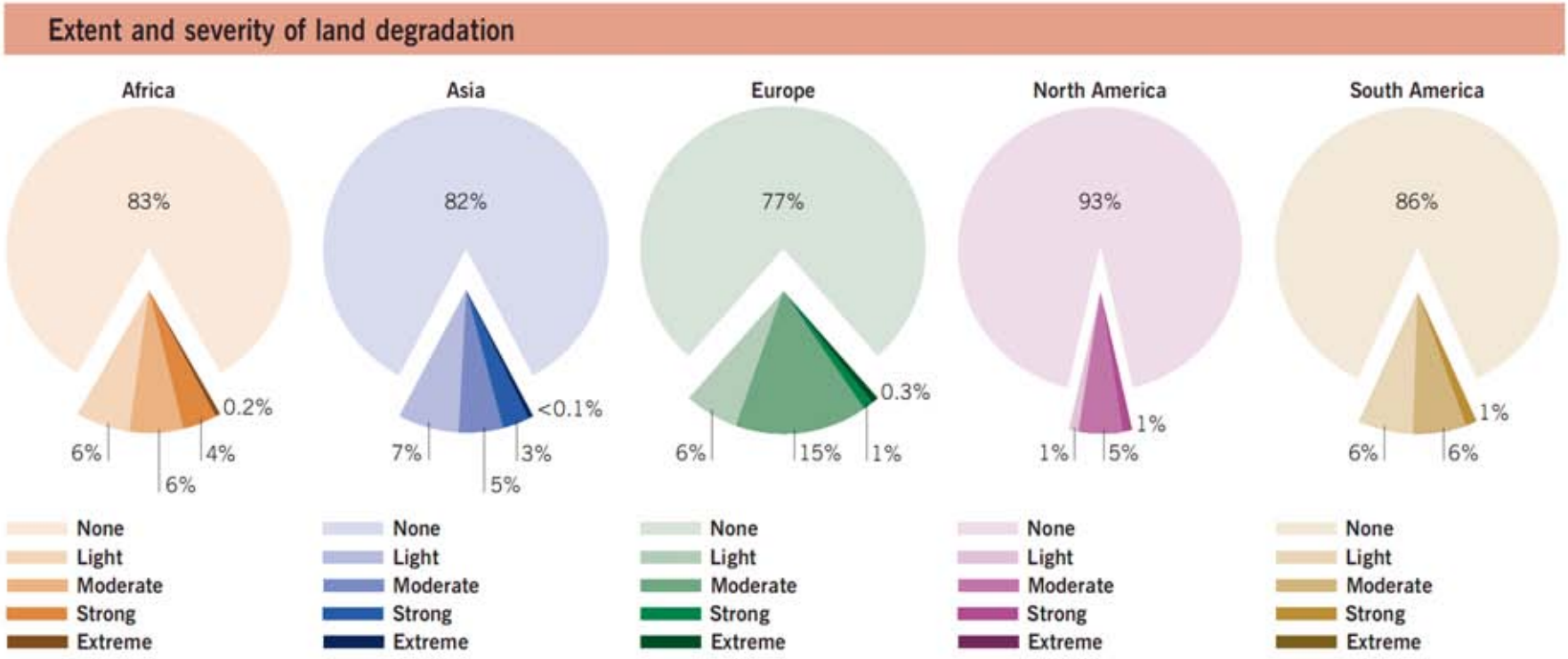

0 1,750 3,500 7,000
Km
Geographic Coordinates
N
LADA
Pressures - Land Degradation Index
Wastelands
Water
High (> 0.75)
Moderate (0.75 to 0.50)
Low (0.50 to 0.25)
Very low (< 0.25)
Source: F. O. Nachtergaele, M. Petri, R. Biancalani, G. van Lynden , H. van Velthuyzen, 2010. Global Land Degradation Information System (GLADIS) version 0.5. An Information database for Land Degradation Assessment at Global Level.


0 1,750 3,500 7,000
Km
Geographic Coordinates
N
LADA
Index of Impacts of Land Degradation Pressures
Wastelands
Water
High
Moderate
Low
Very Low
Source: F. O. Nachtergaele, M. Petri, R. Biancalani, G. van Lynden , H. van Velthuyzen, 2010. Global Land Degradation Information System (GLADIS) version 0.5. An Information database for Land Degradation Assessment at Global Level.

Part II

Land Degradation in Asia

Land degradation worldwide



Land degradation classification

- **Soil degradation** - decline in the productive capacity of the soil as a result of soil erosion and changes in the hydrological, biological, chemical and physical properties of the soil.
- **Vegetation degradation** - decline in the quantity and/or quality of the natural biomass and decrease in the vegetative ground cover.
- **Water degradation** - decline in the quantity and/or quality of both surface and ground water resources.
- **Climate deterioration** - changes in the micro and macro climatic conditions that increase the risk of crop failure.
- **Losses to urban/industrial development** - decline in the total area of land used, or with potential, for agricultural production as a result of arable land being converted to urban, industrial and infrastructure uses.

Categories of soil degradation processes

1) Water erosion
2) Wind erosion
3) Waterlogging and excess of salts
4) Chemical degradation
5) Physical degradation
6) Biological degradation

Asia:

- Large Arid area (central west asia)
- High pressure of population
- Poor natural environment
- Poverty and poor economy
- Economic development and LDC
- Climate change

Cause of Land Degradation

Natural factors:

Human factors:

- Poor agricultural activities:
- Deforestation and removal of natural vegetation:
- Overexploitation of vegetation for domestic use:
- Overgrazing:
- Overexploitation of water resources:
- Industrial activities:

Climate changes:

Land degradation in Central Asia

- Central Asia countries are several affected by drought and desertification, in Turkmenstan and Uzbankstan this figure is 80%; Erosion affected over 88% of arable land in Kirghizstan and 97% of agricultural land in Tajikistan; Over irrigation combined with inadequte irrigation system and reuse of drainage water for irrigation, has lead to water logging and salinization.
- Also in Central Asia, desertification has become environment threat which has serious effects to social and economic development. Agricultural yields has declined 20-30% across the region and agricultural loss from salinization are estimated to be $ 2 billion per year.

LD in Southeast Asia (SEA)

- The mainland component of southeast Asia (SEA) is several affected by land degration and loss of biodiversity and deforestation coupled with unsustainable management of natural resoures is causing enomous environment problems, including land degradation.
- Island component of the SEA constitutes a unique patchwork of marine, coastal, island, terrestrial and agricultural ecosystem with great variations regularly occurring over small distances.

Part III

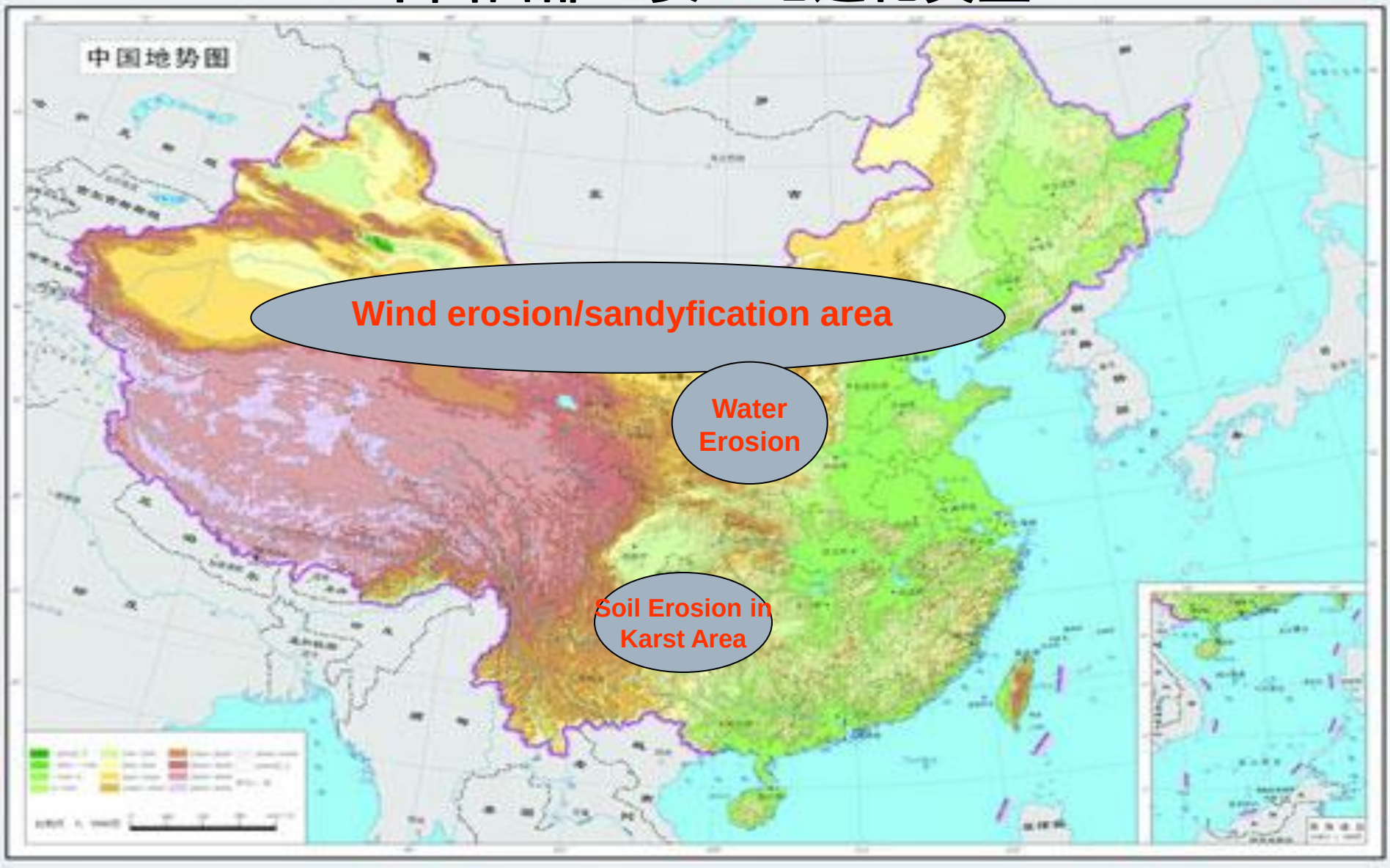
LD/LDC/SLM in Western China

1. Key Types of LD in west China

中国西部主要土地退化类型

- Desertification in northwest China in form of Wind Erosion;
- Desertification in Loess Plateau in form of Soil Erosion by water
- Desertification in South/southwest China Karsts Region in form of erosion
- Some Biodiversity Loss in West China
- Degradation of Wetland in past 60 years

Key Types of LD in China
中国西部主要土地退化类型



Land Degradation in West China

- Sandyfication **沙漠化**

  1.731millon KM2，take 18.03% of total land area

- Soil erosion in Loess Plateau **黄土高原水土流失**

  337,000 KM2，take 53% of Loess Plateau 。

- LD in Karst Region **石漠化**

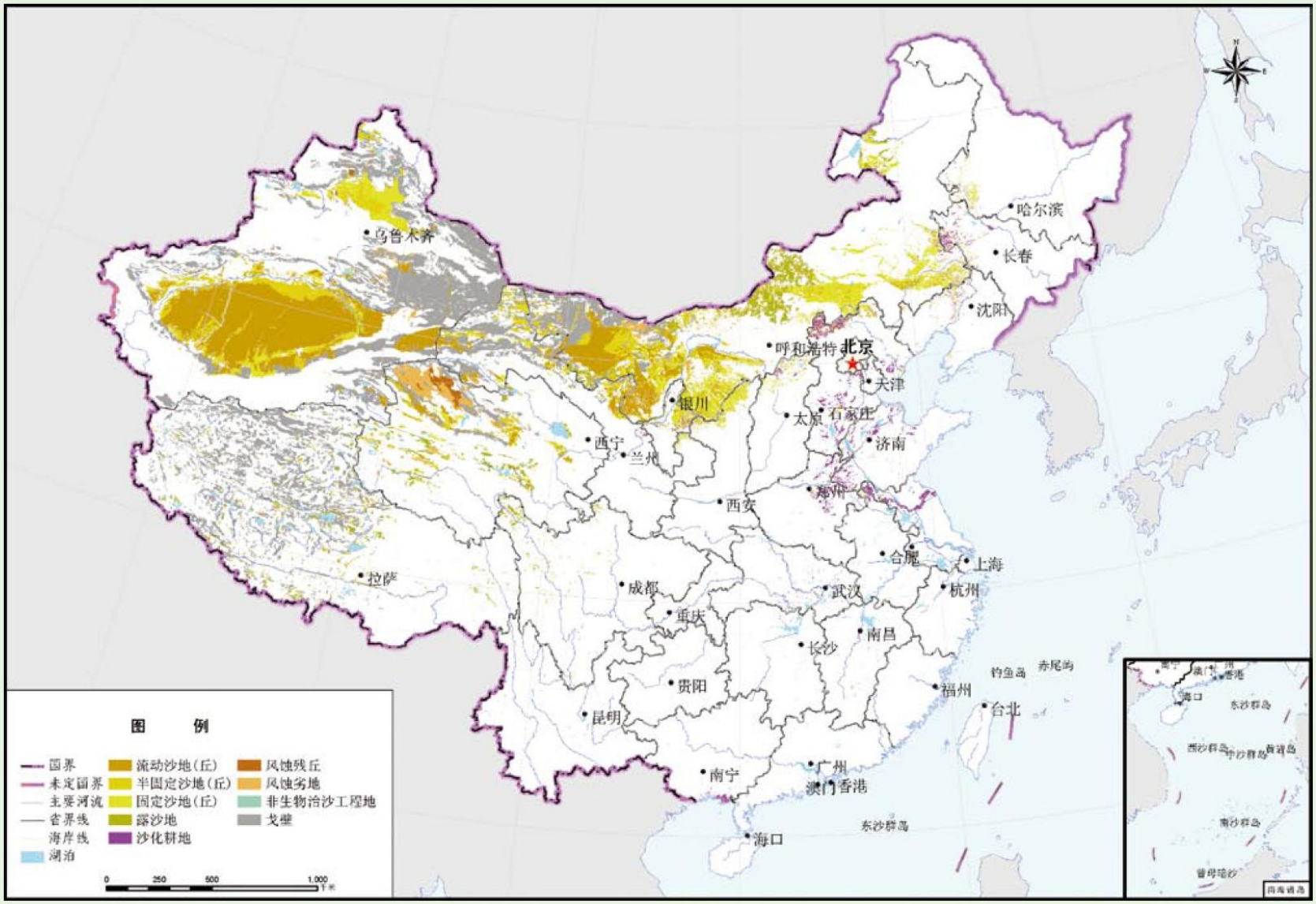
  120,000 KM2，take 26.5% of the 8 provinces

- Biodiversity loss & Wetland degradation

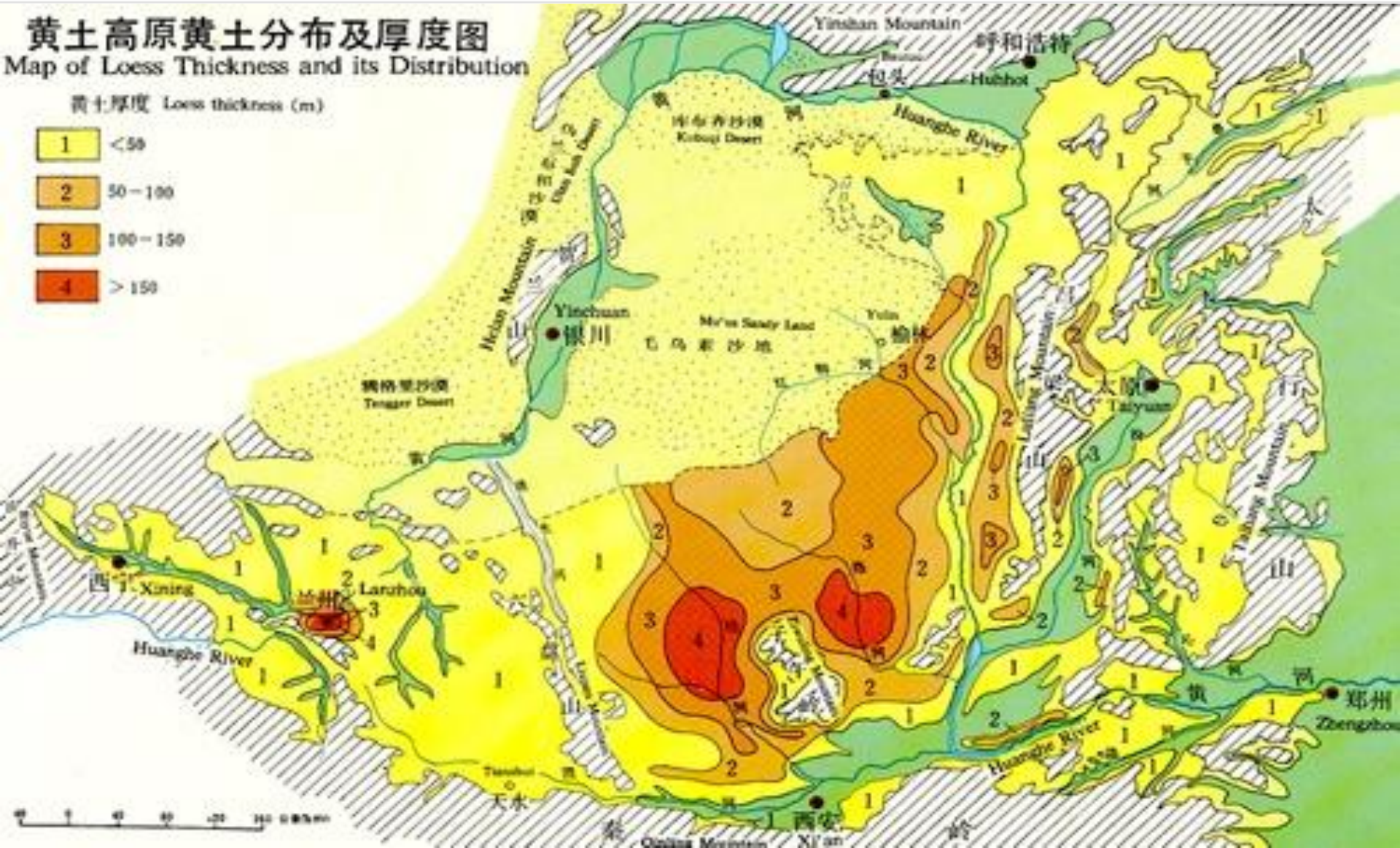
  生物多样性及湿地退化

中国沙化土地现状分布图（2009）

Map of Distribution of Sandification in China



Soil Erosion in Loess Plateau by water
中国黄土高原水土流失



Soil Erosion and It's Changes in Loess Plateau

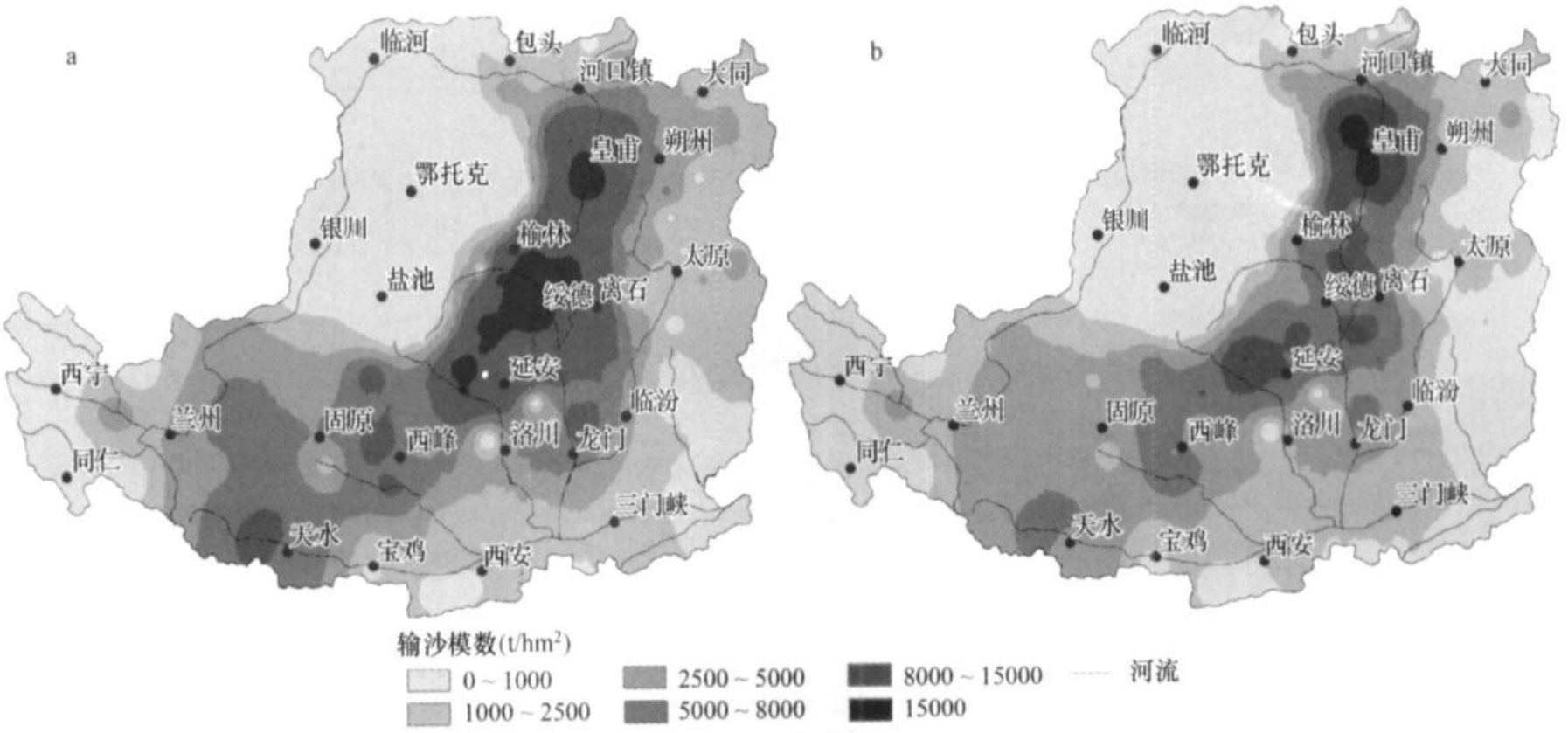
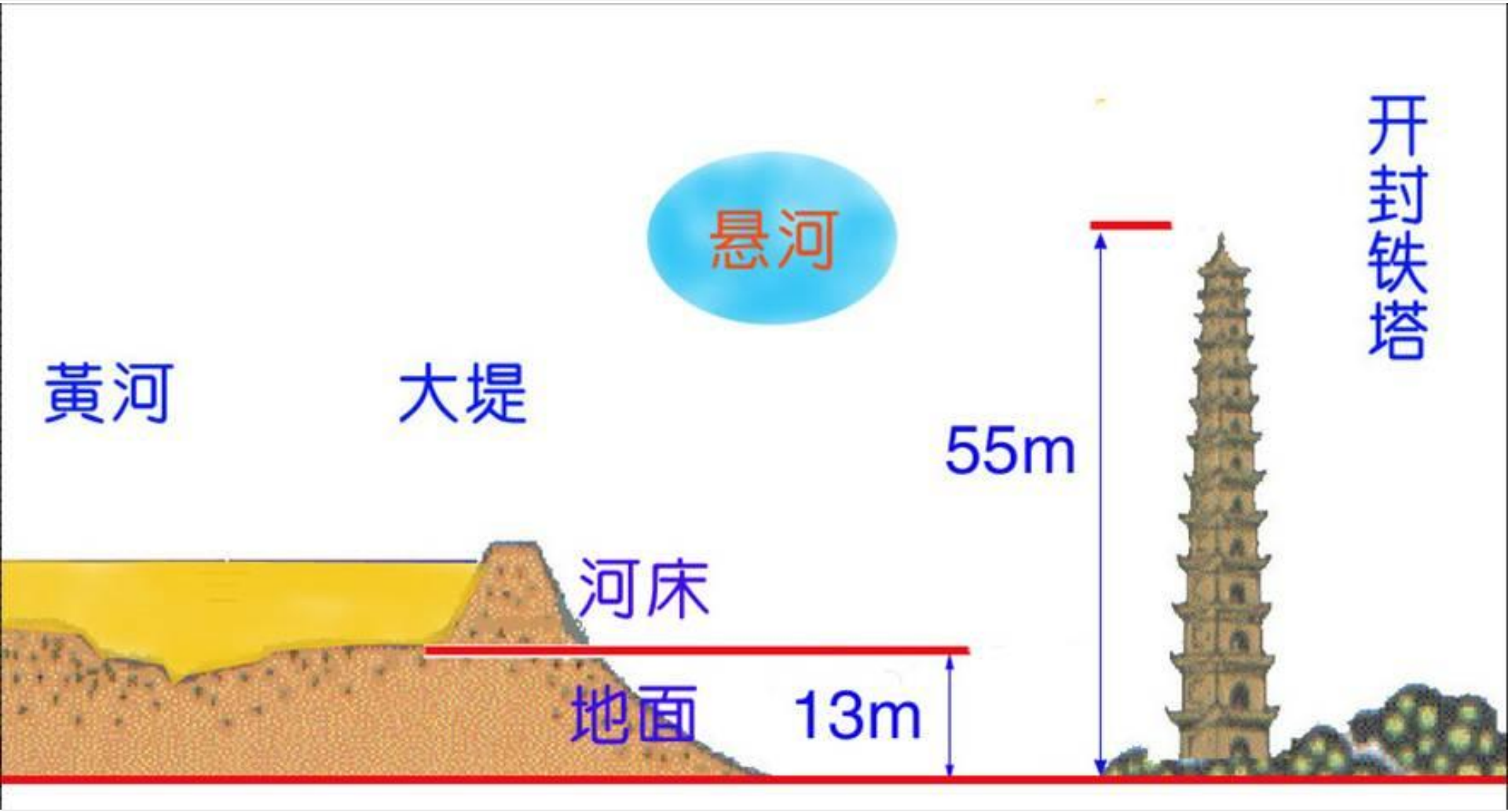


Fig XX. Spatial pattern of sediment yield of the Loess Plateau

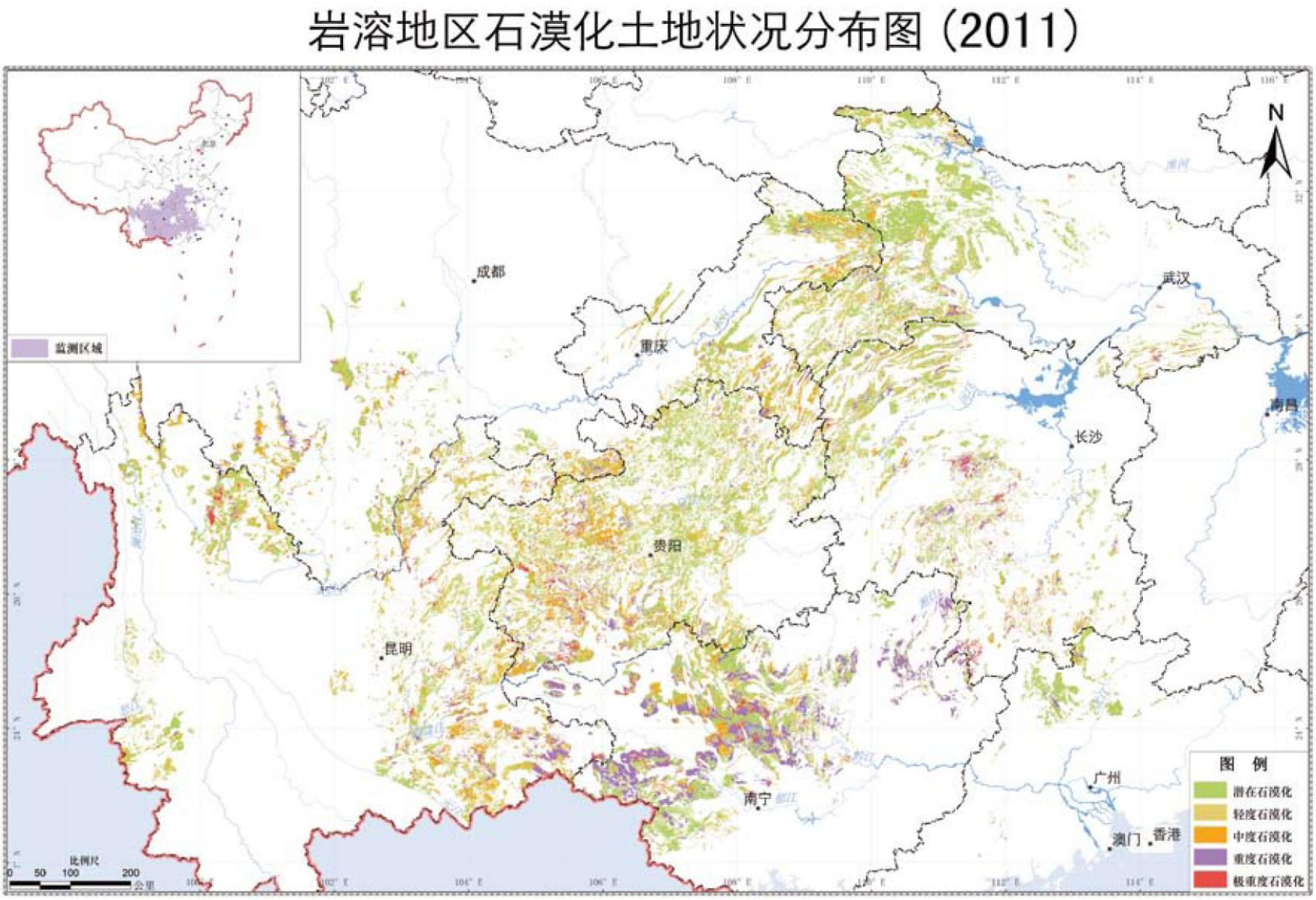
a: 治理之前的侵蚀产沙格局(1956-1969 年) The mean annual sediment yield during 1956-1969;

b: 治理之后的侵蚀产沙格局(1970-1989年) The mean sediment yield during 1970-1989

Damages of soil erosion in Yellow River Watershed 水土流失危害



Desertification in Karst Region of China



Wetland Degradation & Changes in west China
中国西部湿地退化状况

- Reduce in area
- Pollution in water
- Over/un-rational development

Caohai in Guizhou,

Hongjianlao’er in Yulin north Shaanxi

Wuliangsuhai in Inner Mongolia

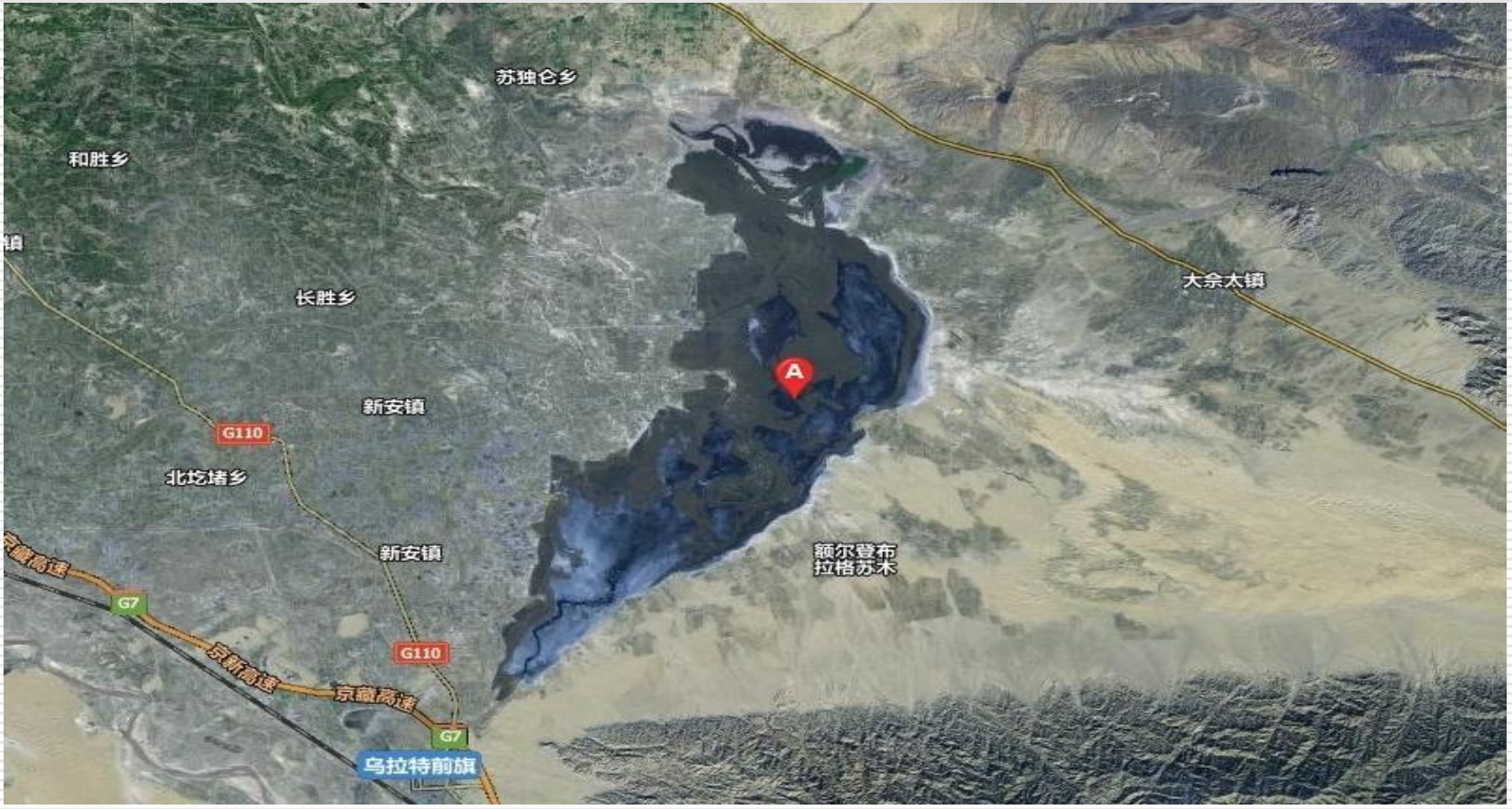
Aibi Lake in Xinjiang

Shahu lake in Ningxia (Siertan in Yanchi)

Caohai in west Guizhou Province

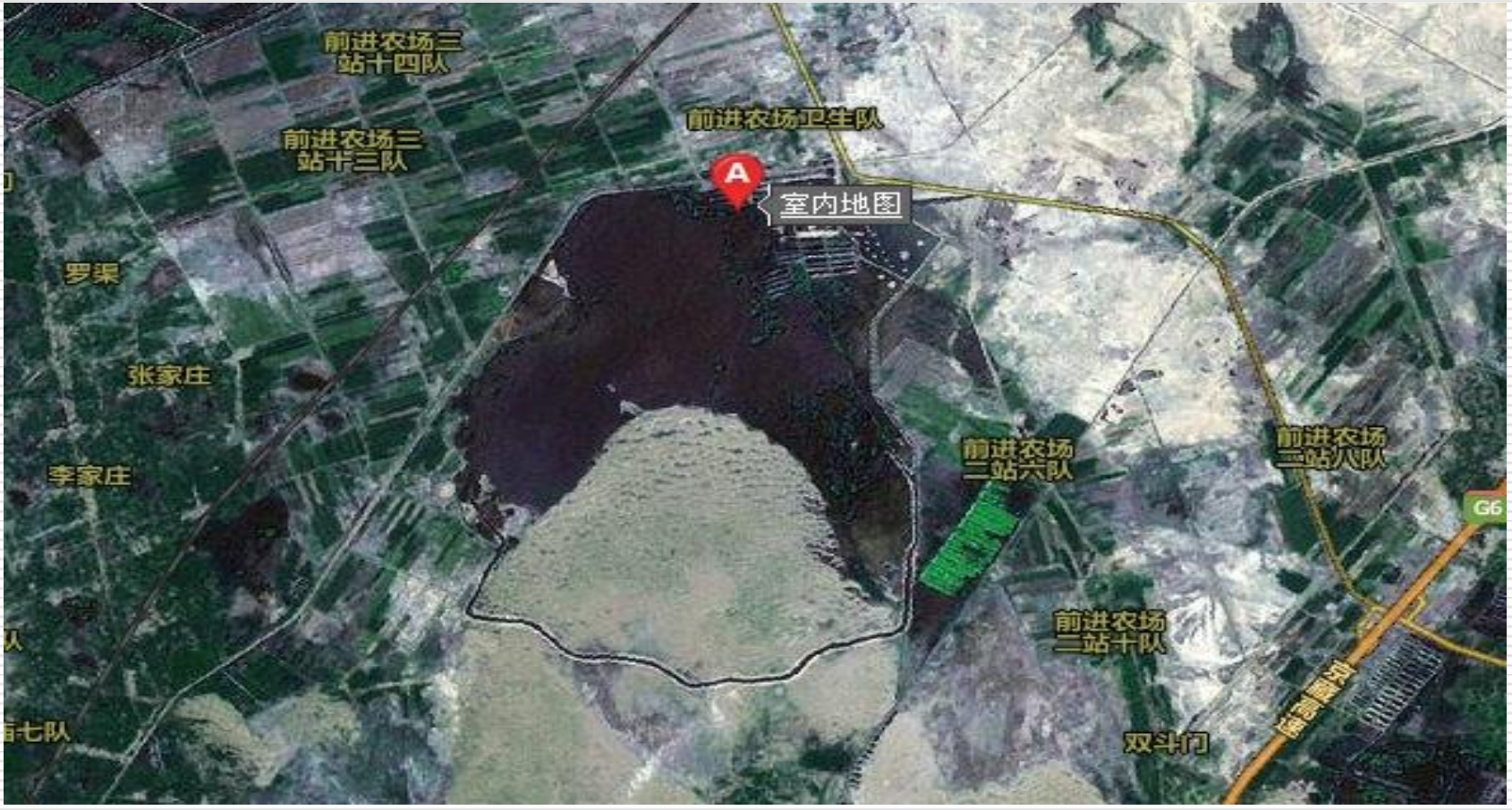
Hong Jian Lao in north Shaanxi

Wuliang-suhai in Inner Mongolia
内蒙古乌梁素海

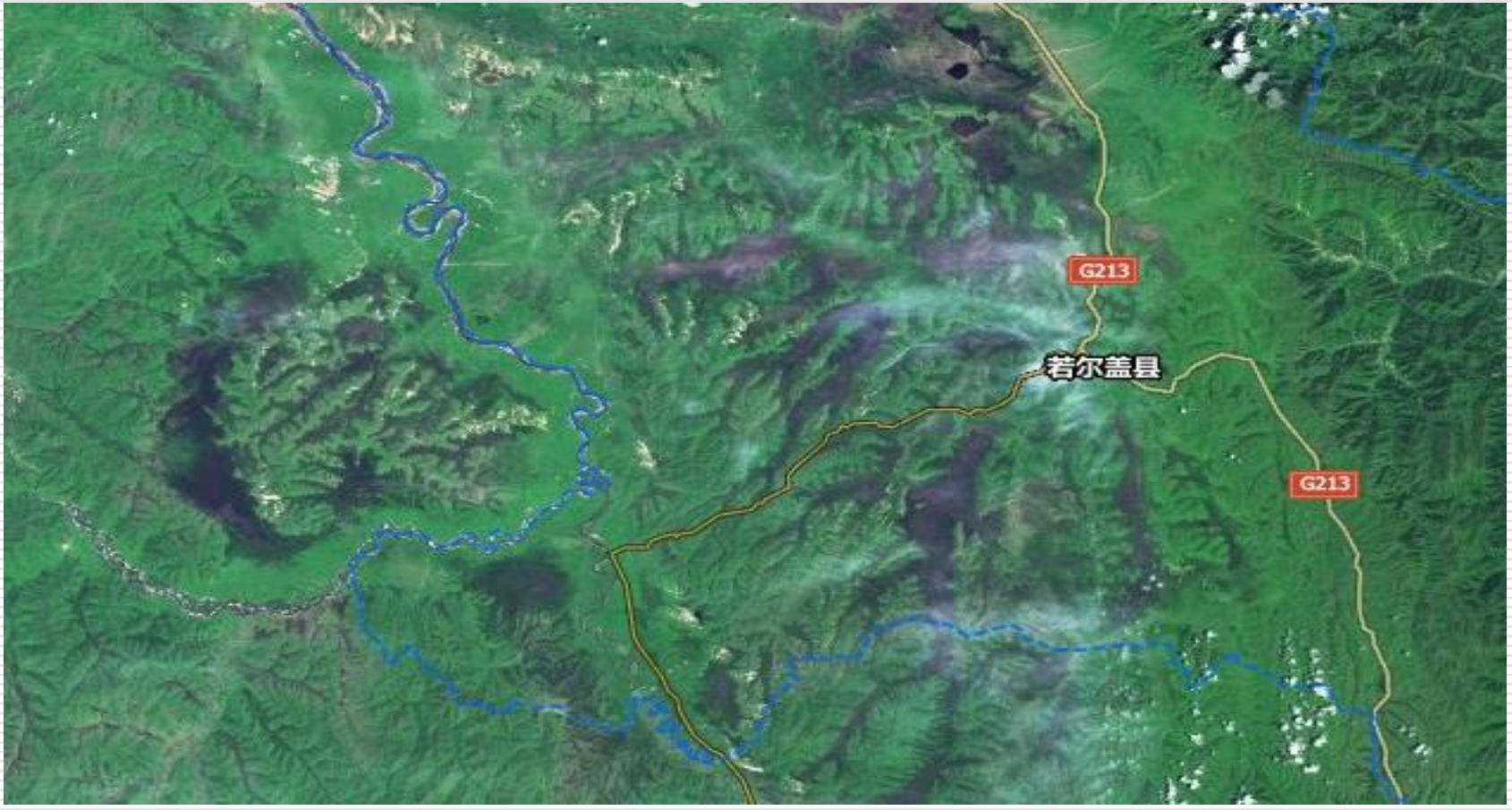


Sha-hu Lake in Ningxia

宁夏沙湖



Ruo-Er-Gai in northwest Sichuan Province
川西北若尔盖湿地



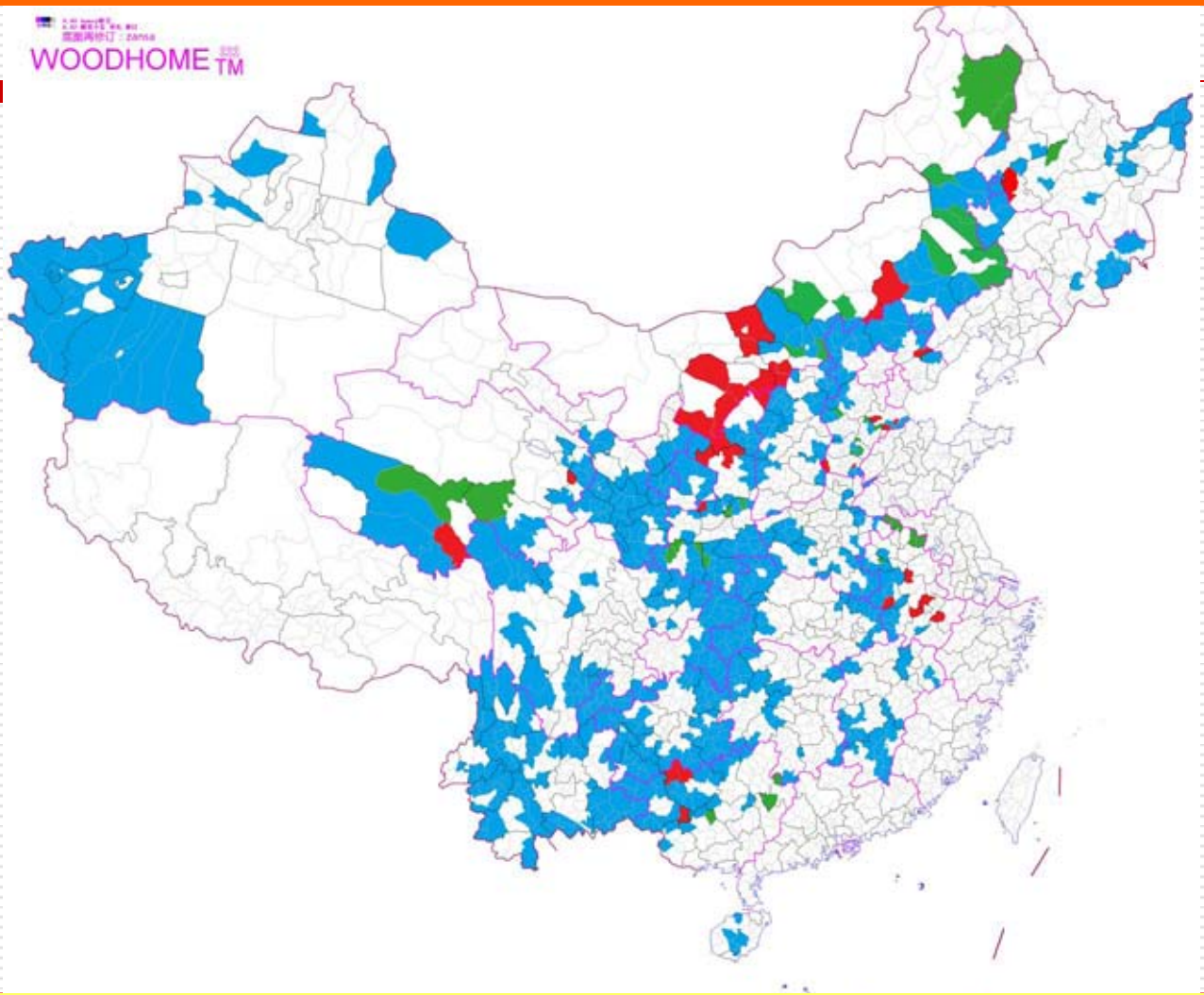
Xinjiang Aibi Lake 新疆艾比湖

Larus relictus National Reserve in Erdos
鄂尔多斯忆颐保护区

2. LD and Poverty in China: 土地退化与贫困

National Poverty Counties Distribution in China/2012

（红色退出/绿色新进）



Total 592 national poor counties in 2011 which the criteria is about $1.8/daily income with total population 128 million.

3. Approaches to LDC/SLM in China
中国土地退化防治及可持续土地管理

- Legal & Regulations
  (**protection: prohibition & rehabilitation-economic way**)
- Mechanism innovation (institution arrangement, PES, allocate responsibility for LDC);
- Government financial investment;
- Scientific & technological supporting;
- To improve productivity measures;
- To develop and expand special industries in LD regions;
- Desertification monitoring;
- Capacity building/Public awareness raising in LDC/SLM;
- To enhance international cooperation (UNCCD, China-African cooperation).

4. Measures/Progress in LDC/SLM in China
中国近年来荒漠化防治成就

- Law system is basically established;
- Policy mechanism initial established;
- Scientific planning in national desertification combating;
- Desertification combating investment mechanism perfected;
- Desertification monitoring system established in China;
- Implementations of UNCCD in China enhanced and good relationship established between China and the Secretariat of UNCCD and other UN bodies.

4.1 Laws and regulations system in LDC/SLM

法律体系进一步完善

Laws related to Desertification and land degradation:

- **Law of Combating Desertification**
- **Forest Law**
- **The Grassland Law**
- **Law of Soil and Water Conservation**
- **Law of Water Resources**
- **Land Contract Law**
- **Law of Land Management**
- **Law for Environment Protection**

Regulations related to Desertification and land degradation:

- Regulation of Reversion of farmland to forest
- China 21 Agenda
- China National Program for Ecological Environment Improvement
- Forestry Action Plan for China 21 Agenda
- Regulation for sandy land contracts and combating desertification
- **National Action Plan to Combat Desertification (NAP)**

中华人民共和国
防沙治沙法

中华人民共和国
水土保持法

中华人民共和国
森林法

中华人民共和国
环境保护法

中华人民共和国
草原法

中华人民共和国
土地管理法

中华人民共和国
气象法

4.2 Institution Arrangement
中国防治荒漠化协调小组成员单位
CCICCD Members ministries for UNCCD in China

国家林业局	State Forestry Administration
外交部	Ministry of Foreign Affairs
国家发展改革委员会	State Development & Reform Commission
财政部	Ministry of Finance
农业部	Ministry of Agriculture
国土资源部	Ministry of Land & Resources
铁道部	Ministry of Railway
交通部	Ministry of Communication
水利部	Ministry of Water Conservancy
商务部	Ministry of Commerce
环境保护部	Ministry of Environment Protection
民政部	Ministry of Civil Affairs
中国人民银行	People's Bank of China
国家税务总局	State Taxation Administration
中国科学院	Chinese Academy of Sciences
国务院扶贫办	Poverty Alleviation Leadership Group of State Council (SC)
国家农业综合开放办公室	Integrated Agricultural Development Office of SC.
中国气象局	China Meteorological Administration

4.3 Policy mechanism in LDC/SLM
防治荒漠化政策机制基本建立

- Government investment in national key projects;
- National financial subsidy policy;
- Public investment;
- Contract and responsibility system (last to 70 yrs);
- Favorable tax policy;
- Favorable credit policy;
- National policy (who: investment-benefit-inherit);

4.4 Scientific planning and integrated control /IEM

China National Action Plan to Combat Desertification (NAP China)

Integrated & practical measure in combating desertification
综合防治措施体系

粘土沙障
秸秆沙障
公路固沙
公路绿化
Clay barrier for sand-fixation
Plant residue barrier for sand fixiation
Sand-fixation along highway by barier
Highway sand-fixation by plantation

封山育林
植物沙障
道路防护林
Close hillside to facilitate forestation
Plant barrier for sand-ixation
Shelterbelt along road

农林间作
农田防护林
水平梯田
地膜覆盖
Agroforestry
Shelterbelt for farmland protection
Terrace for soil & water coservation

生物沙障
飞播造林
退耕还林
植物固沙
Biological barrier for sand-fixation
Acrial seeding for sand-fixation
Reversion of farmland to forest
Plantation for sand-fixation


Live Barriers of Karagana
Vertical Barriers
Sand Fixation Barriers
Clay Barriers
Straw checkerboards

4.5 Investment mechanism in LDC
荒漠化防治投资机制基本建立

- National key project invested by central government;
- Local farmer invest by labor power;
- Public participated;
- International loans;
- Enterprises participated.

National Forestry Ecological Programs（SFA）

重点防护林体系建设工程、退耕还林工程、京津风沙源治理工程、野生动植物保护及自然保护区建设工程、重点地区以速生丰产用材林为主的林业产业基地建设工程。

Shelterbelt Development Programs in Such Regions as the Three North, and the Middle and Lower Reaches of the Yangtze River, the Conversion of Cropland to Forest Program, Beijing and Tianjin Sand-wind Source Control Program, the Wildlife Conservation and Nature Reserve Development Program, the Forest Industrial Base Development Program in Key Regions with a Focus on Fast-growing and High-yield Timber Plantations.

1. 天然林保护工程
   Natural Forest Protection Program

2. “三北”和长江中下游地区等重点防护林体系建设工程
   Key Shelterbelt Development Programs in Such Regions as the Three North, and the Middle and Lower Reaches of the Yangtze River

3. 退耕还林工程
   The Conversion of Cropland to Forest Program

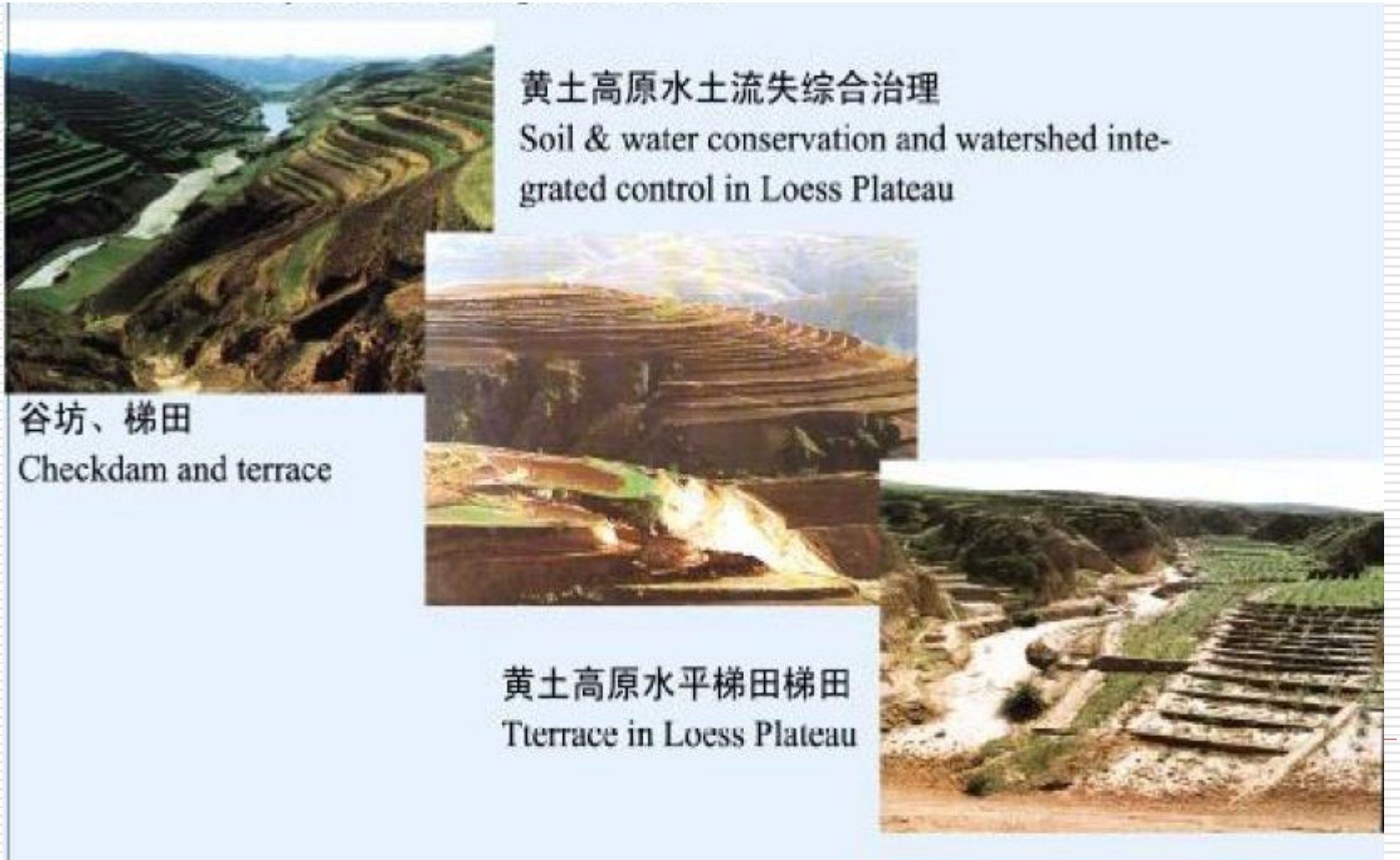
4. 京津风沙源治理工程
   Beijing and Tianjin Sand-wind Source Control Program

5. 野生动植物保护及自然保护区建设工程
   The Wildlife Conservation and Nature Reserve Development Program

6. 重点地区以速生丰产用材林为主的林业产业基地建设工程
   The Forest Industrial Base Development Program in Key Regions with a Focus on Fast-growing and High-yield Timber Plantations

Soil & Water Conservation program (MWR-水利部)

Key Control Project for Sediment Reduction in Middle Reach of Yellow River,
Sand Control Project in Transitional Area of Agriculture and Rangeland,
Oasis Restoration Project in Inland River Catchments have implemented etc..



National Grassland Protection Projects (MoA-农业部)

国家实施了草原保护“八大工程”，包括封育围栏、划区轮牧、人工种草、飞播牧草、改良草场、建设草原节水灌溉设施、建设草原类自然保护区、治虫灭鼠等。

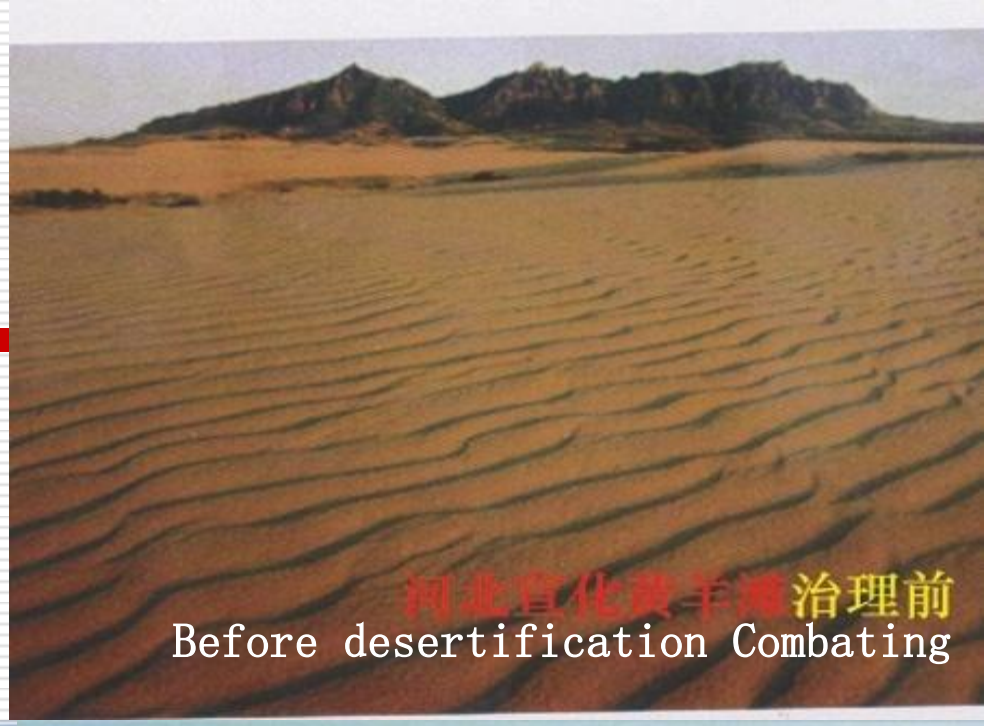
China has also implemented “the Eight Major Programs” of rangeland protection, which include grassland closure and fencing, rotation grazing in zoned areas, grass planting, aerial seeding, grassland improvement, installation of water-saving irrigation facilities, establishment of nature reserves in grassland, pests and rats control etc.

草场改良
Grassland Improvement

封育围栏
Closure and Fencing

人工种草
Grass Planting

Ecological condition has been effectively improved



Baotou-Lanzhou Railway across shifting sand in Shapotou in past 50 years

Baotou-Lanzhou Railway across shifting sand in Shapotou, Ningxia, China
包兰铁路沙坡头防沙治沙

Highway across the shifting sandy desert
新疆沙漠公路

4.6 Restoration & Alternative or Sustainable Livelihoods

Activities of the restoration & alternative or sustainable livelihoods include planting of medicinal herbs, cash tree planting, solar energy, greenhouse, biogas digester, mushroom cultivation, pasture development and livestock production facilities, etc.. The objective of alternative and sustainable livelihood activities is to increase beneficiary farmers' income at the same time of reducing their dependence on the NNRs to enhance the protection of ecosystems and BD conservation


IFAD
GEF
GEF项目支持岢岚县
乐龙综合农业专业合作社简介


GEF项目潘家湾经济林
建设示范点

4.7 LD/desertification monitoring

Since China signed UNCCD in 1994, FOUR terms (1994, 1999, 2004,2009) of national desertification monitoring have been carried out. It provide the basement for policy makers in making NAP in combating desertification

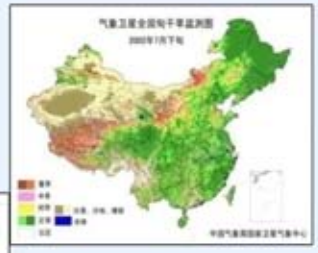
Desertification monitoring classification:

- **National desertification monitoring:**
- **Key (sensitive) regions monitoring:**
- **On-site monitoring:**
- **Dust & sandstorm monitoring.**

Desertification monitoring system in China

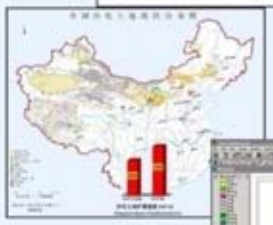
中国荒漠化监测体系由全国宏观监测（包括荒漠化和干旱）、重点地区及典型定位监测、荒漠化治理工程效益监测、沙尘暴监测等部分组成。自公约签署以来，先后完成了两期全国荒漠化监测（1994、1999）。

China national desertification monitoring system consists of national monitoring (including drought monitoring), sensitive region monitoring, in-situ monitoring in typical areas and key project benefits monitoring and sandstorm monitoring. Two terms (1994 and 1999) national desertification monitoring have been carried out since signing of the UNCCD.



中国沙化土地监测样线分布图
Distribution Map of Transect for Desertification Monitoring

全国干旱监测
Drought monitoring at national level



全国宏观监测
Macro Monitoring at national

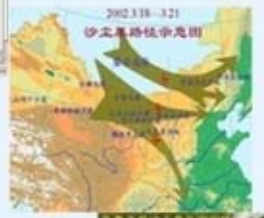
重点地区监测
Sensitive Region Monitoring

定位监测
Stationary monitoring

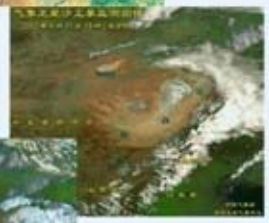
中国中央气象台于2001年开始发布沙尘暴预报。目前中国可以成功进行沙尘暴预报。同时，中国气象局开设了专门沙尘暴网站，介绍沙尘暴知识，发布沙尘暴预报，提高公众沙尘暴灾害预防意识，减少沙尘暴损失。网站依托网络技术、信息技术、数据库技术，为公众提供一个方便实用的、全方位的有关沙尘暴资讯的科研和服务交流的工作平台。

China Central Meteorological Station (CMS) began sandstorm forecasts in its daily weather forecasts for the first time in early spring of 2001. Now from early winter to later spring, China Central Meteorological Station has been carrying sandstorm forecast. The CMS also set up China Duststorm Network (www.duststorm.com.cn) to introduce sandstorm knowledge and to rising public awareness in combatig sandstrom and reduce ecnomic loss.

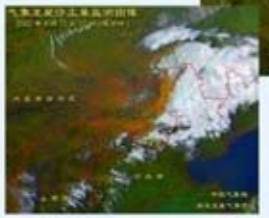
中国沙尘暴监测网
Network of China Duststorm



沙尘暴路径
Route of sandstorm in China



沙尘暴监测
Sandstorm monitoring

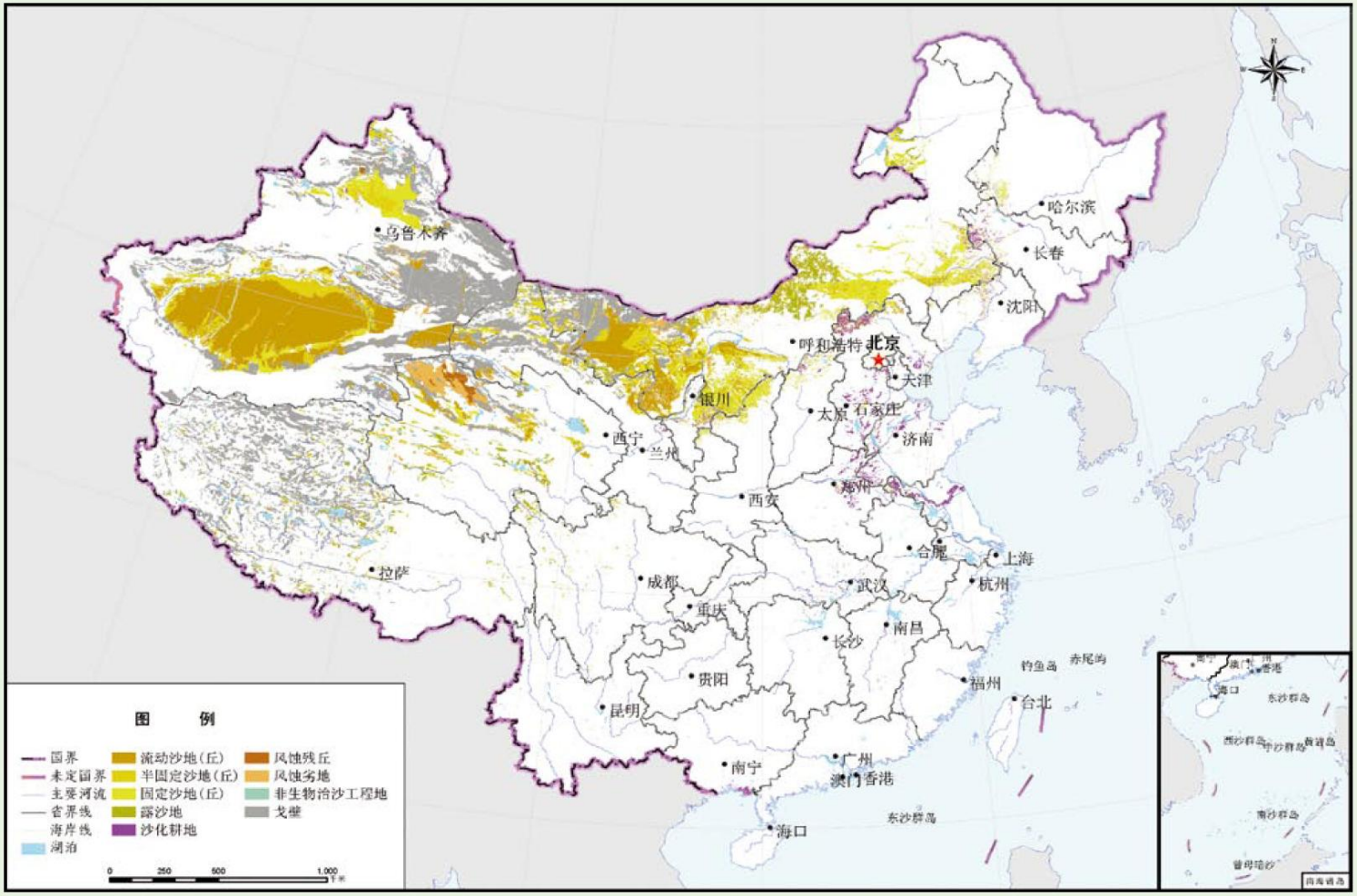


2001年4月7日沙尘暴遥感监测结果
Sandstorm monitoring on April 7, 2001.

Desertification distribution in China (4/2011)

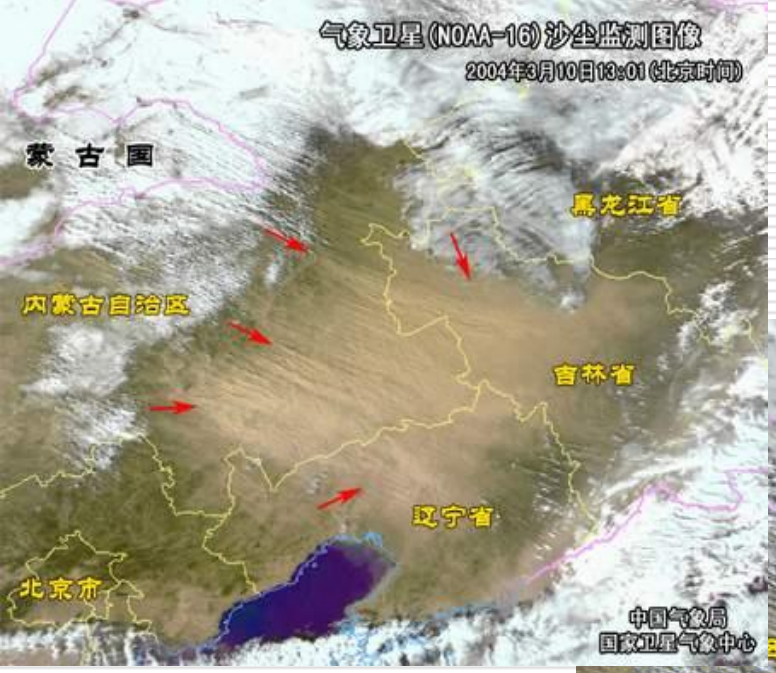
中国沙化土地现状分布图（2009）

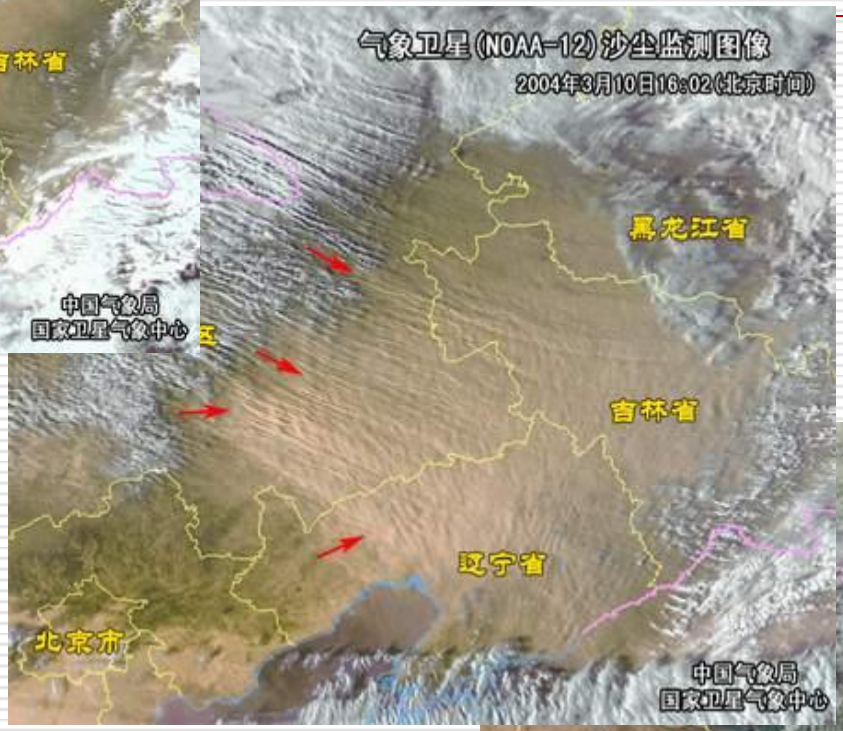
Map of Distribution of Sandification in China

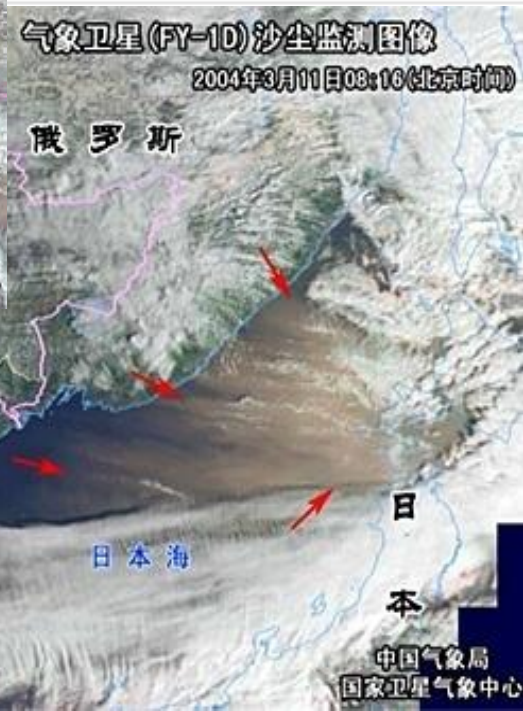


Desertification Monitoring in China

13:01→16:02 → 08:16/Mar.10-11, 2004







Dust storm in Mar.10-11, 2004

4.8 Public awarness rising in LDC/SLM/CBD

Poster for environment protection and bidiversity conservation

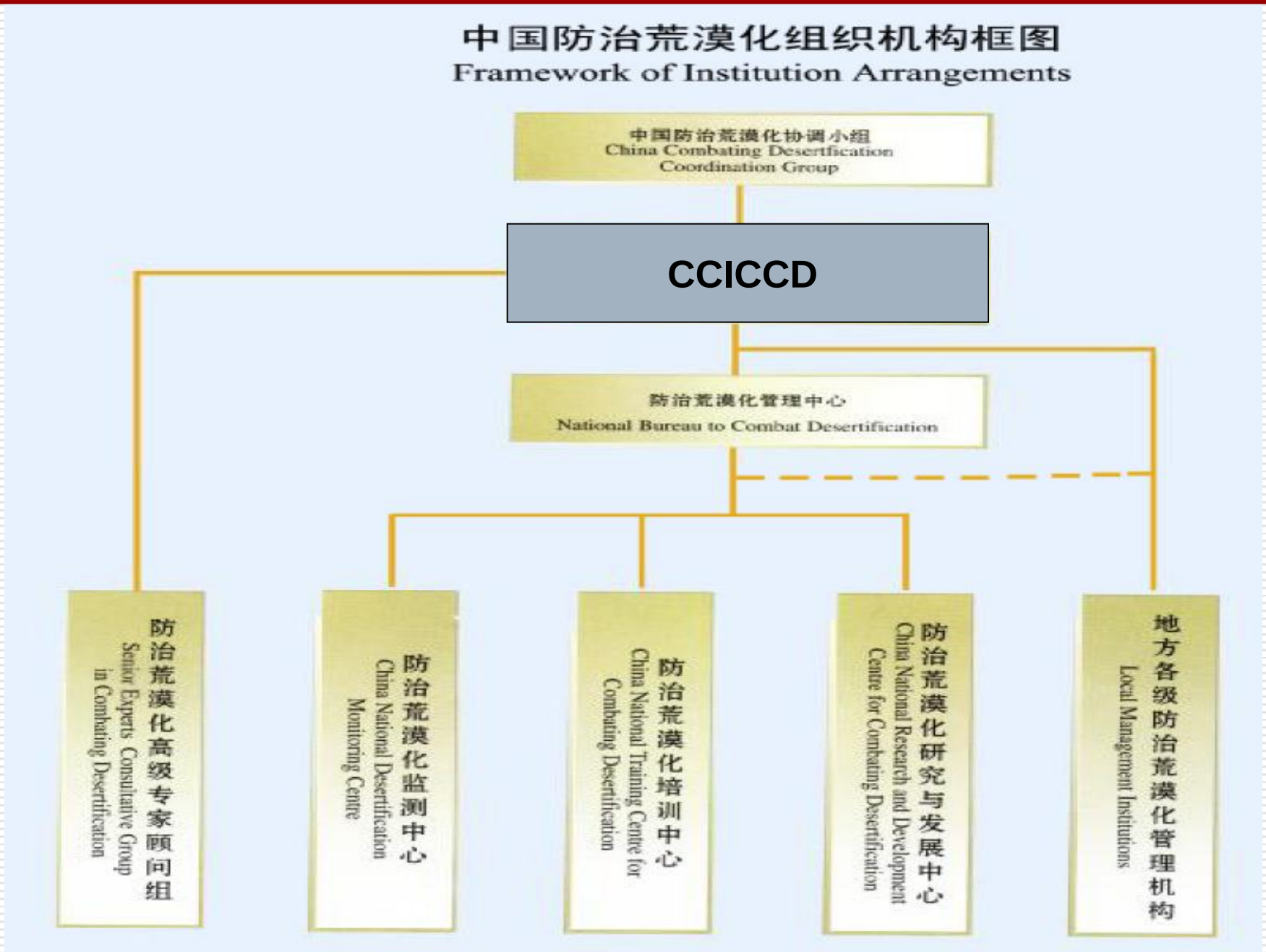
News paper, TV, Website, Cultural Evernts, Painting competition, etc.


甘肃省IFAD/GEF项目


天然补水 温碧泉


GEF
2014 · 07

4.9 Implementations of UNCCD and International cooperation




防治荒漠化国际会议
International Conference on Combating Desertification
Organized by the State Forestry Administration, P.R.China


中国履行《联合国防治荒漠化公约》
国家报告


妇女与防治荒漠化国际会议
Beijing International Conference on Women and Desertification
Organized by: UNCCD Secretariat
UNCCD International Training Centre, Beijing
Supported by: Ministry for the Environment and Territory, Italy
State Forestry Administration, China
Co-supported by: Ministry for the Environment and Territory, Algeria

UNCCD TPN－1 Website located in China

联合国防治荒漠化公约
国际培训中心
International Training Center of UNCCD
Beijing. China

ADB TA：Prevention and Control of Dust and Sandstorms in Northeast Asia：

Ecosystem Restoration along the Silk Road in Western China

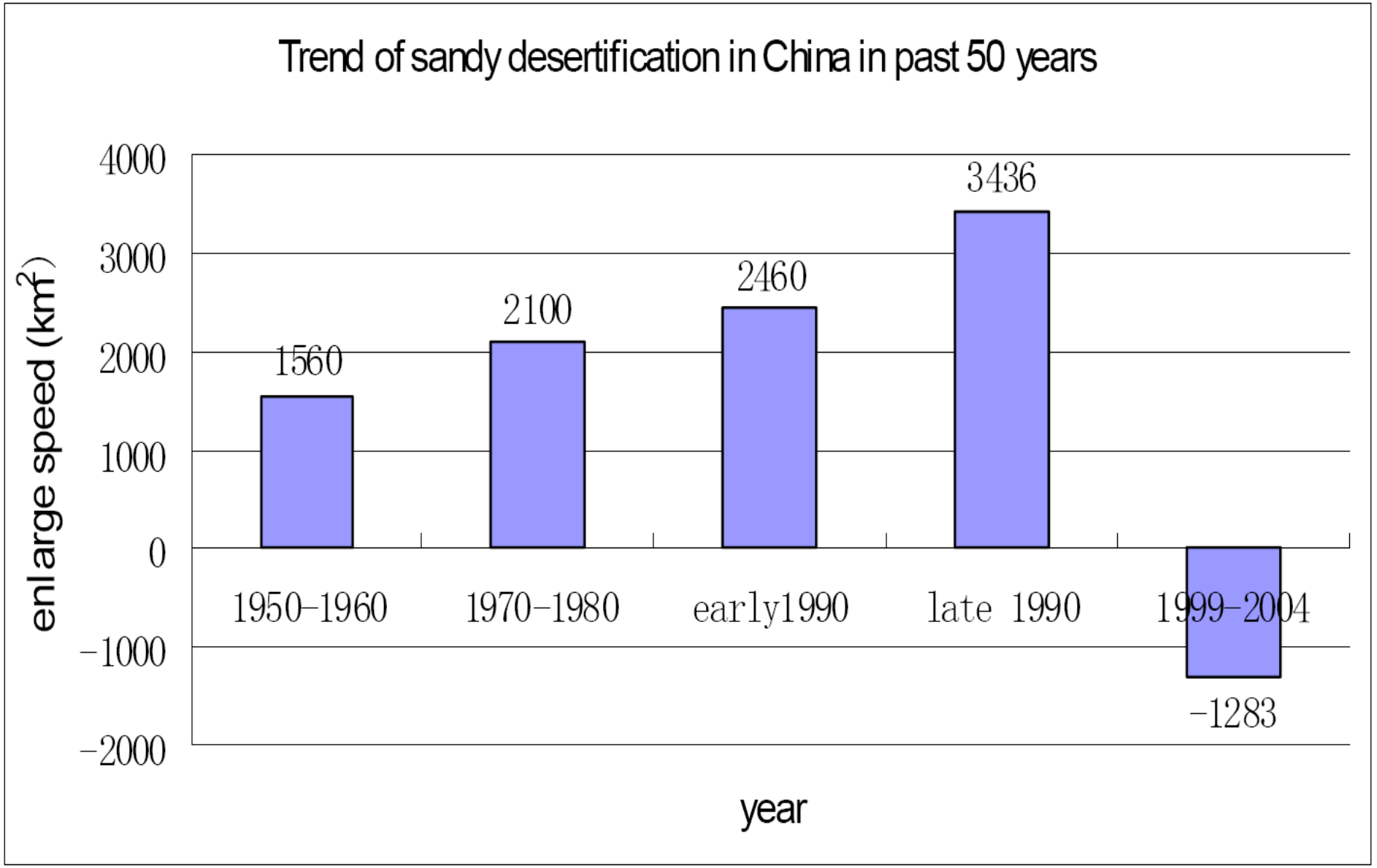
5. Achievements in desertification combating

- **The ecological condition has been effectively improved.** Throughout China about 20% of desertification area has come under control in different degrees. The vegetation cover rate in key areas has increased by over 20% .

- **The economic development has been effectively promoted.** In Beijing-Tianjin Wind & Sand control areas, more than 16 million farmers and herdsmen have benefited directly from the project, compared with 2000, the average income increased by almost almos 100% since 2000.

- **The social benefits have been effectively exploited.**

Trend of sandy desertification in China in past 50 years



6. PRC-GEF Partnership I-II in LDC in West China

Table 1 – Sub-projects financed under the PRC-GEF Partnership on Land Degradation in Drylands

GEF ID	Project Name	Project Area	Focal Area	GEF Agency	GEF Grant	Co-financing Total	GEF
3484	PRC-GEF Partnership - Capacity and Management Support for Combating Land Degradation in Dryland Ecosystems	6 provinces in northwest of China Shaanxi, Gansu, Ningxia, Qinghai, Xinjiang, Inner Mongolia	Land Degradation	ADB	2,728,000	6,200,000	GEF-4
956	PRC-GEF Partnership - Project I-Capacity Building to Combat Land Degradation	6 provinces in northwest of China Shaanxi, Gansu, Ningxia, Qinghai, Xinjiang, Inner Mongolia	Multi Focal Area	ADB	7,700,000	7,300,000	GEF-3
2369	PRC-GEF An IEM Approach to the Conservation of Biodiversity in Dryland Ecosystems	Gansu, Ningxia, Shanxi	Multi Focal Area	IFAD	4,545,000	25,023,580	GEF-4
3483	PRC-GEF Partnership - Silk Road Ecosystem Restoration Project	Shaanxi, Gansu, Xinjiang	Multi Focal Area	ADB	5,120,000	195,200,000	GEF-4
3608	PRC-GEF Partnership - Sustainable Development in Poor Rural Areas	Shaanxi, Chongqing, Henan	Multi Focal Area	IBRD	4,265,000	143,400,000	GEF-4
3611	PRC-GEF Partnership - Mainstreaming Biodiversity Protection within the Production Landscapes and Protected Areas of the Lake Aibi Basin	Xinjiang	Multi Focal Area	IBRD	2,976,000	8,935,000	GEF-4
1621	Gansu & Xinjiang Pastoral Development	Gansu, Xinjiang	Multi Focal Area	IBRD			GEF-3
2788	Ningxia Integrated Ecosystem and Agricultural Development Projec	Ningxia	Multi Focal Area	ADB			GEF-4
4633	Shaanxi Weinan Luyang Integrated Saline and Alkaline Land Management	Shaanxi	Land Degradation	ADB			GEF-5
Total Financing					**27,334,000**	**386,058,580**	

Introduce new Idea, technologies, advanced management, provided fund tec in Law resivement & NAP for CBD & CCD

7. Challenge in LDC/SLM in Asia

- Poor natural environment
- Large area of land degradtion
- Poverty and poor economy
- High population pressure
- Economic development and LDC
- Poor public awarness in LDC and CBD
- Climate change

Thank you for your attention