# Assessment of the Drought & Its Impacts to Forests in Building Community Resilience against Droughts in China

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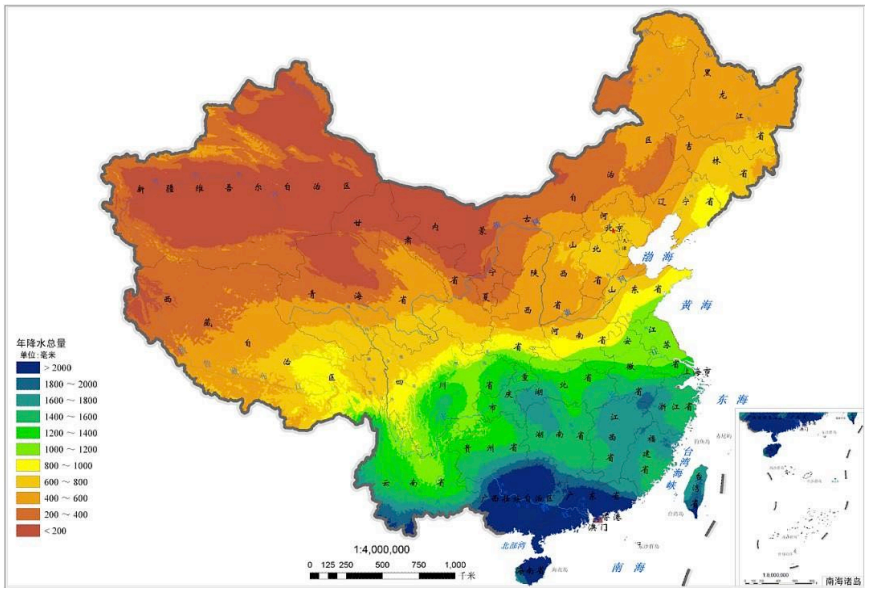
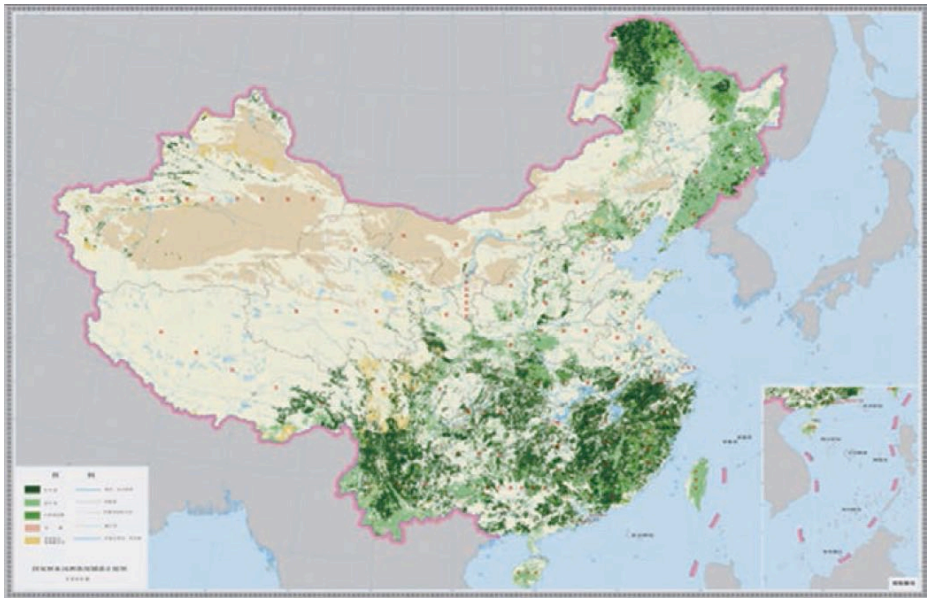
# 1. China Profile



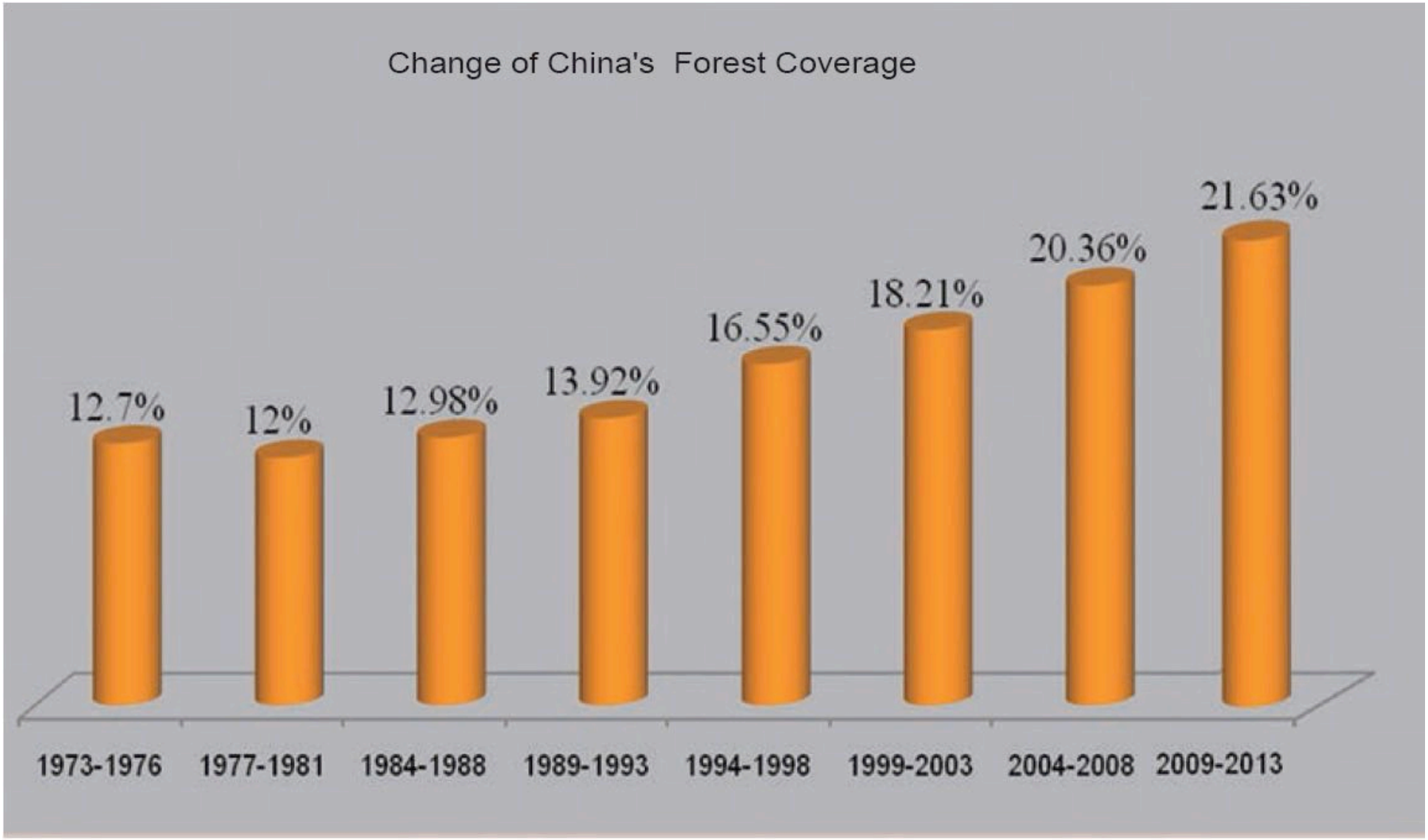
The forest area in China is 208 million hectares and the forest coverage is 21.63% of the total land area. The forest stock volume reaches 15,137 million cubic meters

**Geography:** China has varied landscape. The eastern coastal plains, the highlands, and the fertile valleys of the Yellow River and Yangtze River are the most highly populated areas in China. The Tibetan plateau, which is hemmed in by the Himalayas, is in western China, the world's highest mountain, Everest, is on the Nepal-Tibet border. Some areas in the northwest are desert areas or covered by grass, while the southeast boasts some of the world's most lush forests, including the bamboo forest that is the giant panda home.

**Climate:** The climate in China is as varied as its landscape. While northeast China has cold winters and warm summers, the east-central region has more rainfall and milder winters. A wet, subtropical climate is prevalent in the southeast, while in the west the weather is colder and harsher.

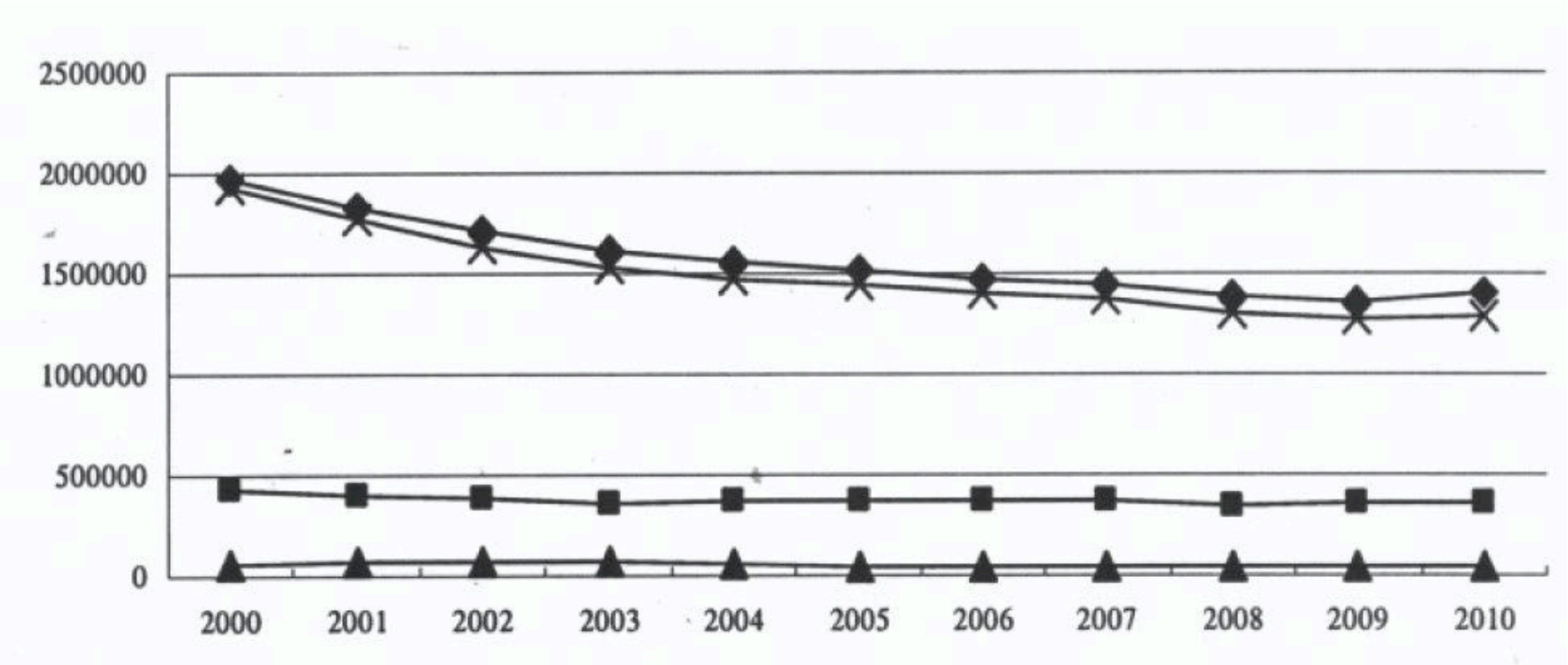
**The total forestland area 310.46 million ha.**

- Forested land is 191 .17 million ha,
- Open forest land is 4.01 million ha,
- Shrub land is 55.90 million ha,
- Unestablished forest land is 7.11million ha,
- Land suitable for forest is 39.58 million ha，
- Other forestland (including nursery land, non-stocked forestland and the land used for forestry auxiliary production) is 12.69 million ha.




**Change of Forest Coverage in China from 1973-2013**

It is very dificulty to statistic the number of forest dependent people in China. Based on the China ‘s GDP in 2014, forestry take **about 8.3% (5.26/63.6)** of total GDP. Which one can roughly calculated forest dependent people in China. It is about **11.288 million** people working in forest sector.




**Human resources in national forestry systrm (2000-2010)**

# 2. Drought in China

**Drought classification in China (by days without rain)**

| Region | Slight | Moderate | Severe | Extream Severe |
|---|---|---|---|---|
| South China | 10～20 | 21～30 | 31～45 | >45 |
| North China | 15～25 | 26～40 | 41～60 | >60 |

| No | Drought Degree | | Slight | Moderate | Severe | Extream Severe |
|---|---|---|---|---|---|---|
| 1 | Continuous days without rain in growth season | | 10-20 | 21-30 | 31-45 | >45 |
| 2 | Distance to the mean rain (%) | 1 month | -60 to -75 | -75 to -80 | -80 to -85 | <-85 |
| | | 2 month | -30 to -40 | -40 to -45 | -45 to -50 | <-50 |
| | | 3 month | -20 to -30 | -30 to -35 | -35 to -40 | <-40 |

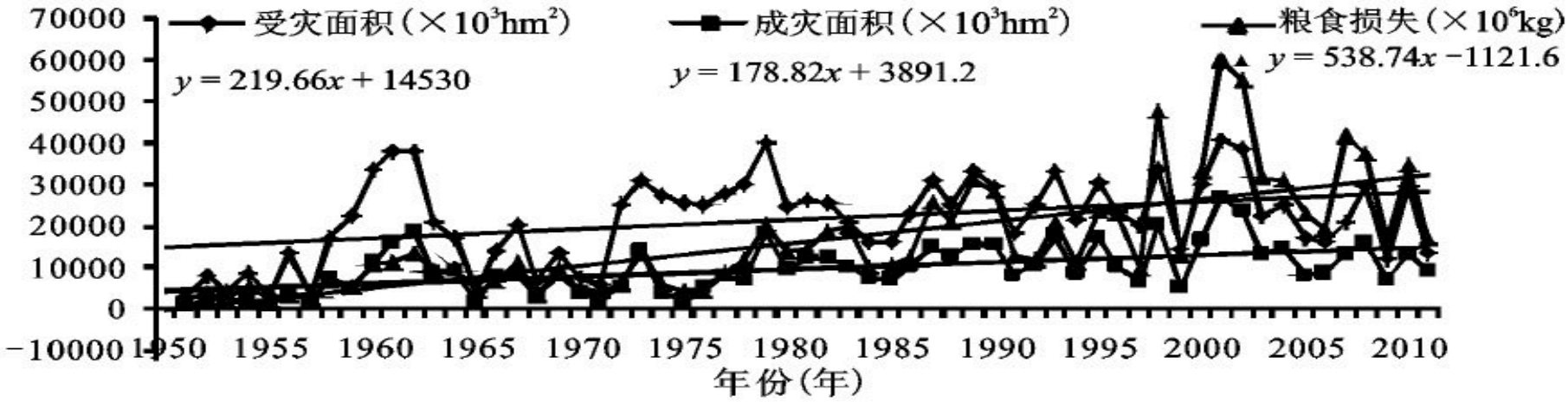



图1　1950~2010年中国干旱灾害成灾、受灾面积和粮食损失时间变化

Change of damaged, affected area and grain lost by drought damages in China in 1950-2010

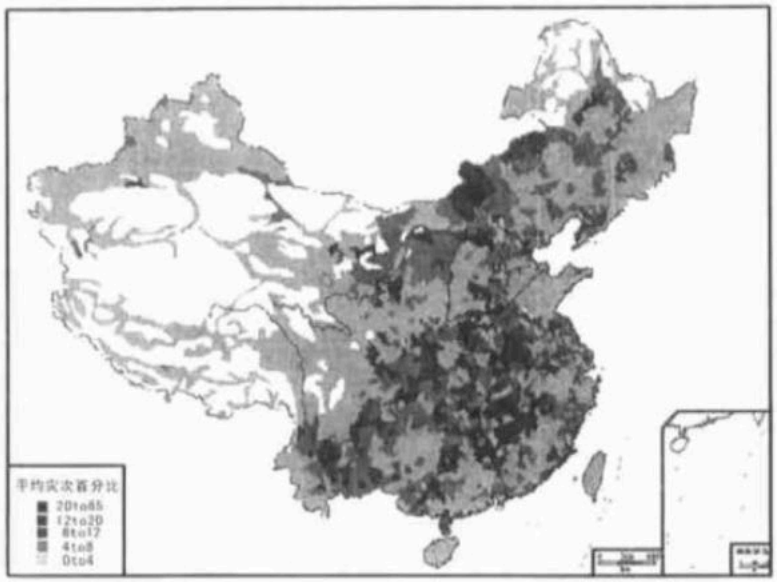



图 1　1949 – 1965 年中国旱灾灾频图

Fig. 1　Frequency of drought disaster in China from 1949 to 1965

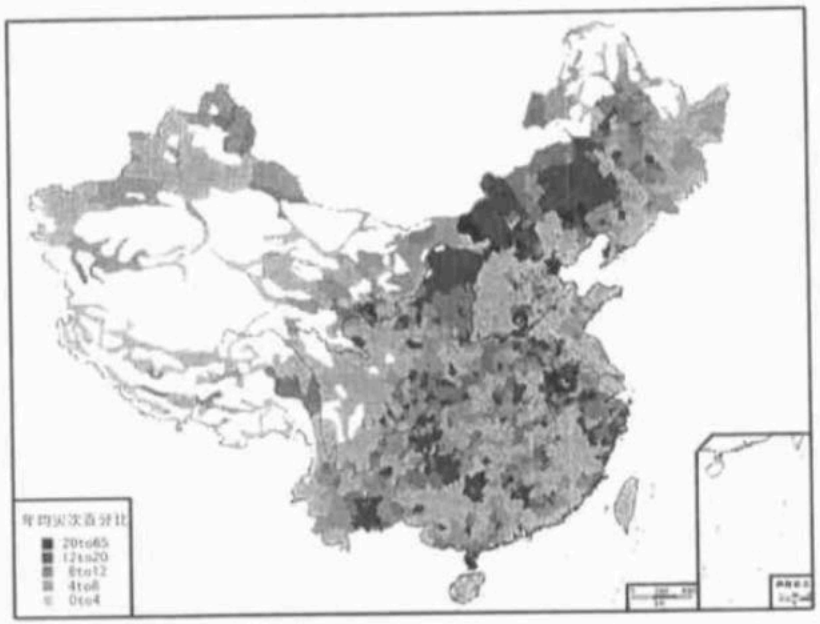



图 2　1978 – 2000 年中国旱灾灾频图

Fig. 2　Frequency of drought disaster in China from 1978 to 2000

**Spatio-temporal change of drought disaster in China from 1949-2000**

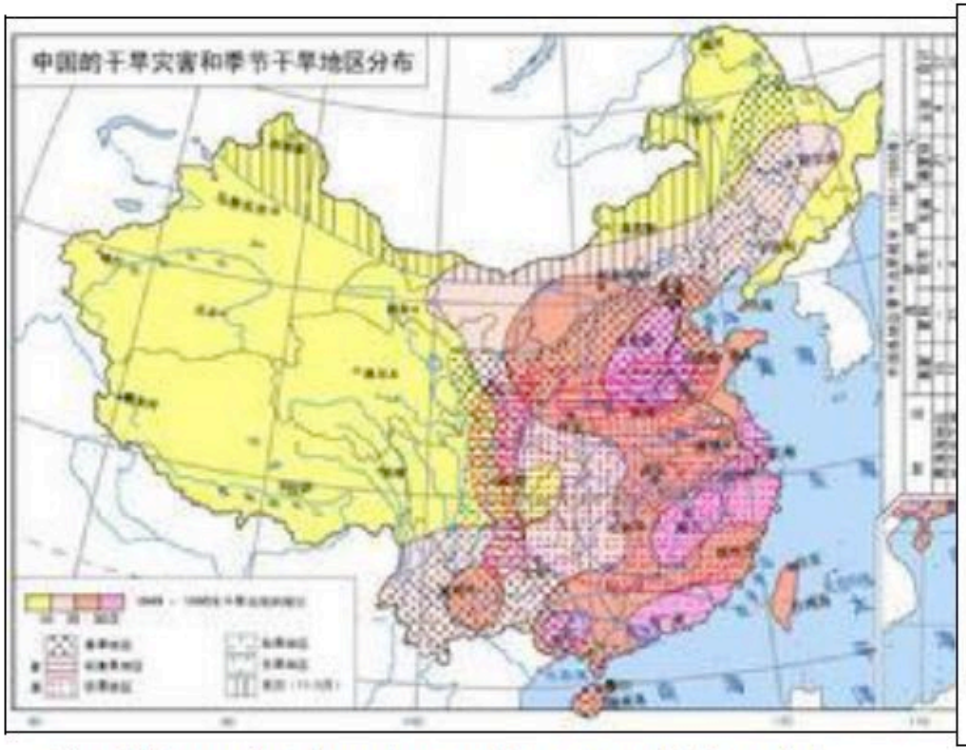



Fig.8 Drought disaster and seasonal drought distribution in China.

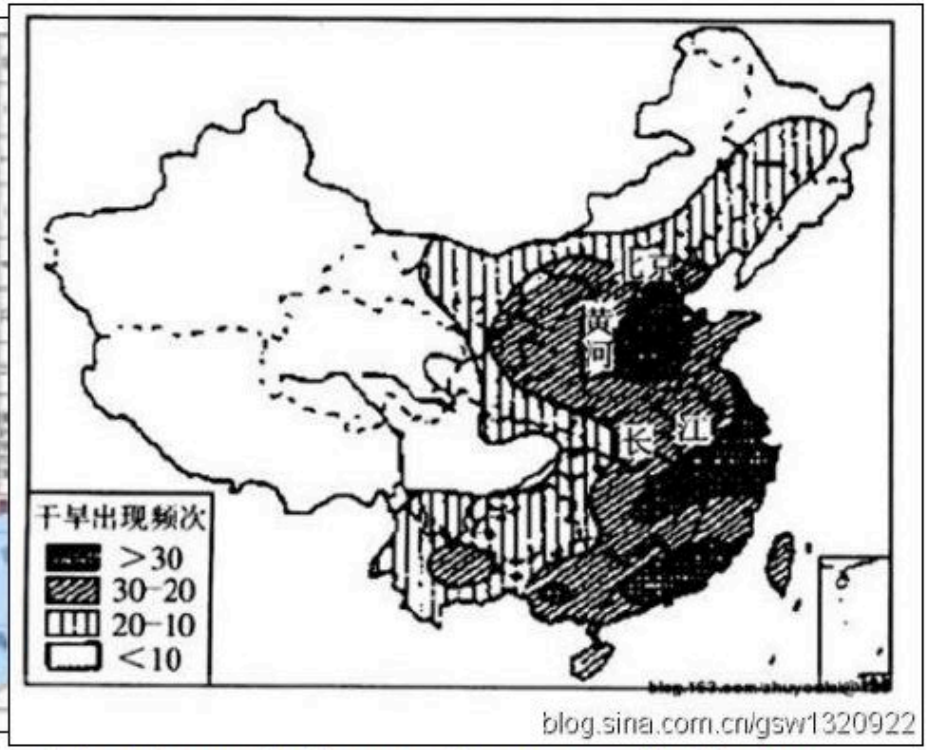



Fig.9 Drought disaster frequency distribution in China.

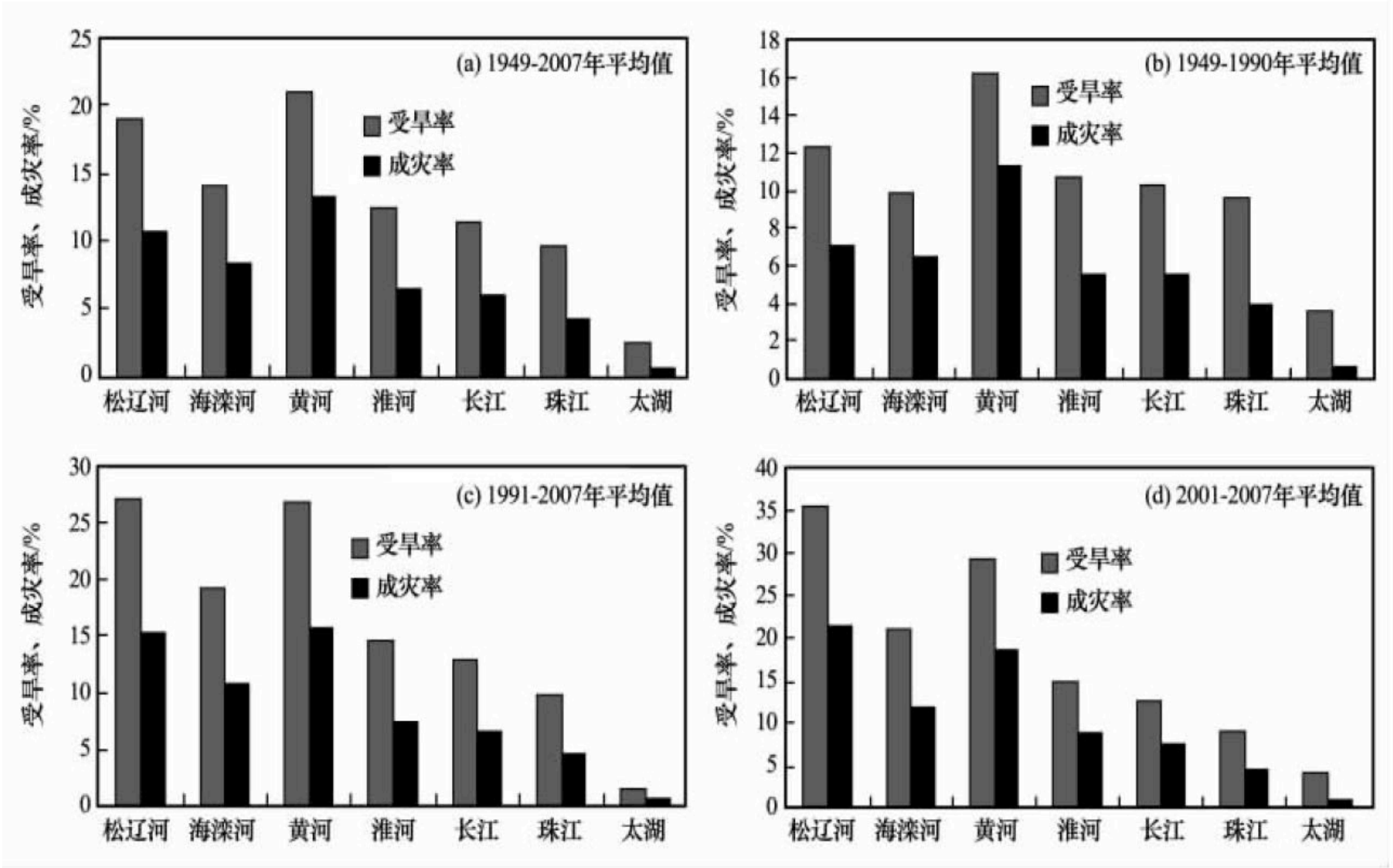



图 4　全国各流域平均灾情统计

Fig. 4　The drought-occurring area ratio and the drought-induced disaster area ratio in various drainages from 1949－2007 and 1991－2007

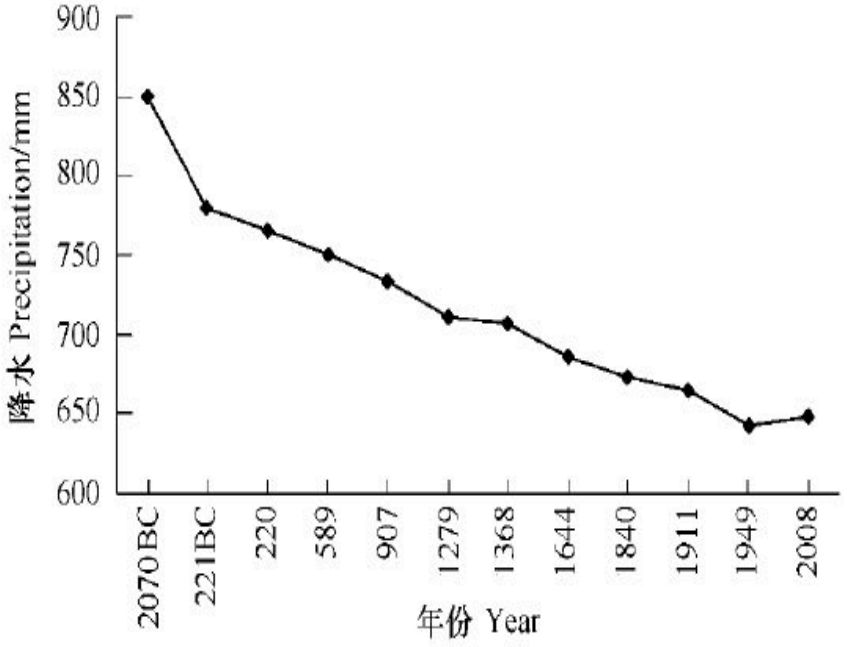



图 2 近 4000 a中国降水变化趋势

Fig. 2 Precipitation change since 4000 aBP in China

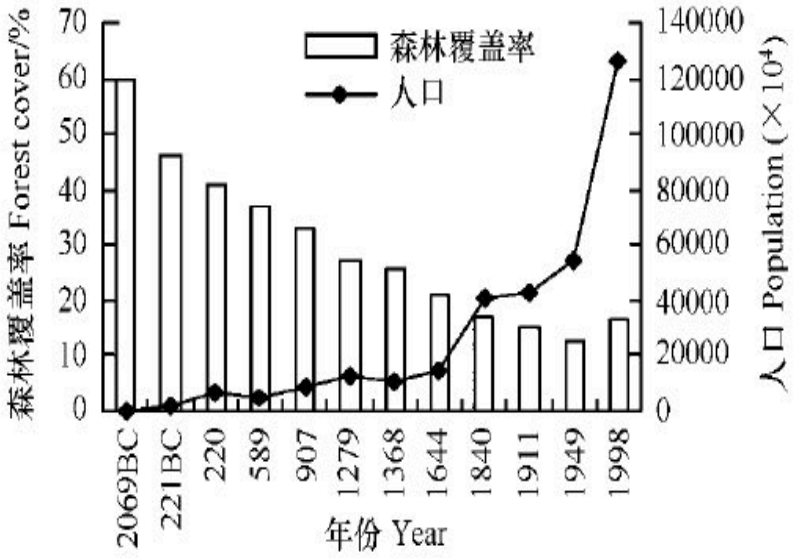



图 3 中国历代森林覆盖率和人口变化

Fig. 3 Changing of forest cover and population in history

**Rainfall, population and forest coverage in China (2070BC-2000)**

# 3. Case Study: Southwest Drought 2009-2012

- Large scale in China ( 5 provinces with 51,049,000 people affected);
- Longest duration (4 year from 2009-2012);
- Caused serious economic loss;
- Caused whole social concerns not only China by Xinhua News Agency CCTV, but also worldwide (BBC news);
- Central Government paid great in reducing the impacts of drought and economic loss. And led some policy adjustment for poverty reduction

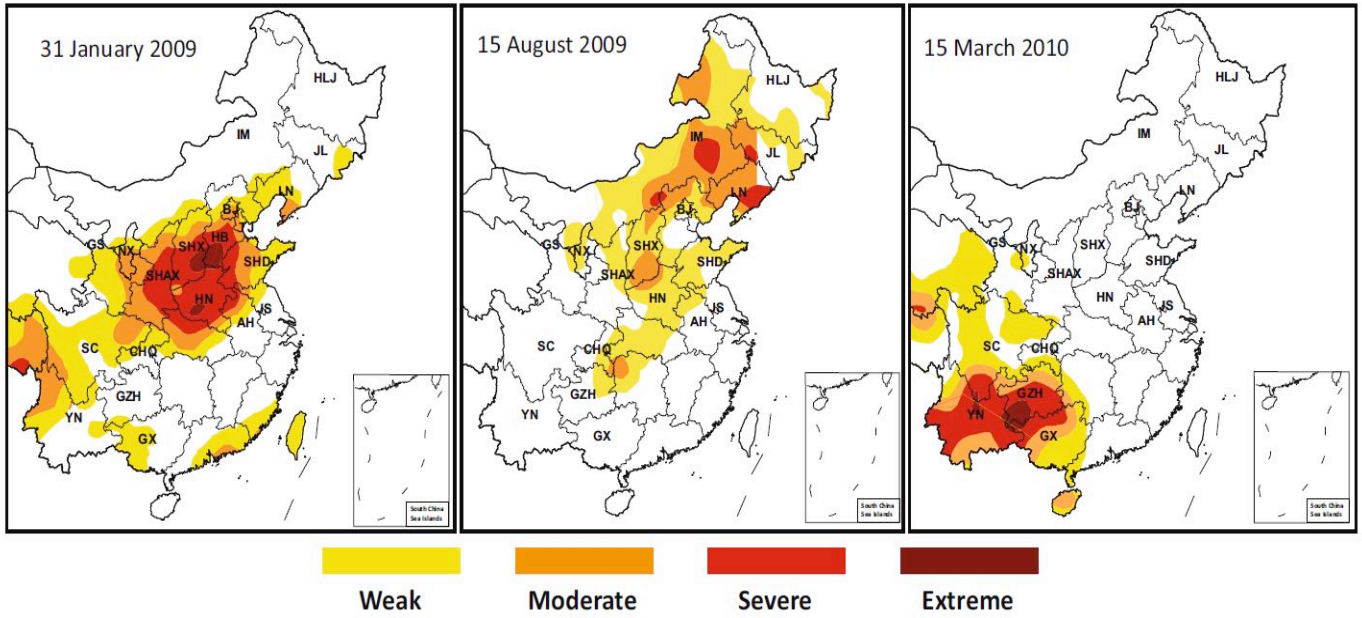



**Figure 1. Snapshots of the spatial pattern of the 2009–2010 severe droughts in China**

Abbreviations: HLJ—Heilongjiang Province; JL—Jilin Province; IM—Inner Mongolia Autonomous Region; LN—Liaoning Province; BJ—Beijing Municipality; TJ—Tianjin Municipality; HB—Hebei Province; SHD—Shandong Province; SHX—Shanxi Province; SHAX—Shaanxi Province; HN—Henan Province; AH—Anhui Province; JS—Jiangsu Province; CHQ—Chongqing Municipality; SC—Sichuan Province; GZH—Guizhou Province; YN—Yunnan Province; GX—Guangxi Province.

Data source: China National Climate Center 2009–2010.

**Table 1. Basic features of the 2009–2010 severe droughts in China**

| Features | 2009 spring drought[a] | 2009 summer drought[b] | 2010 spring drought[c] |
|---|---|---|---|
| **Starting** | Mid-Nov. 2008 | End-Jun. 2009 | Early-Sep. 2009 |
| **Ending** | End-Feb. 2009 | Early-Nov. 2009 | Early-May 2010 |
| **Duration** | 3 months | 5 months | 6 months |
| **Peak date of the drought** | 7 Feb. 2009 | 16 Aug. 2009 | – |
| **Major areas affected** | The major producing area for winter wheat, including HN, AH, SHD, JS, SHX, HB, and GS | Southeast IM, north SHX, north HB and LN, southwest JL and HLJ | GX, YN, GZH, SC, and CHQ |
| **Meteorological cause** | Relatively high temperature and low precipitation | Low precipitation | High temperature and low precipitation |
| **Return period** | 30–50 a | 50–100 a | 50–100 a |

Data source: [a]China National Climate Center 2009a; [b]China National Climate Center 2009b; [c]China National Climate Center 2010.

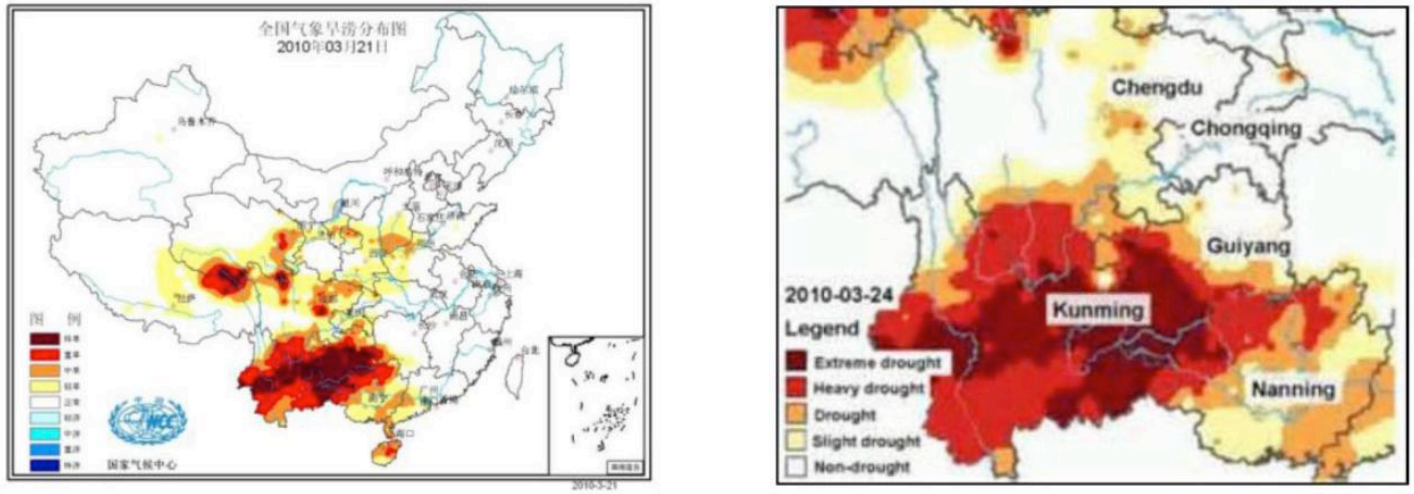



Fig. 15 Drought in Southwest China 2009-2012

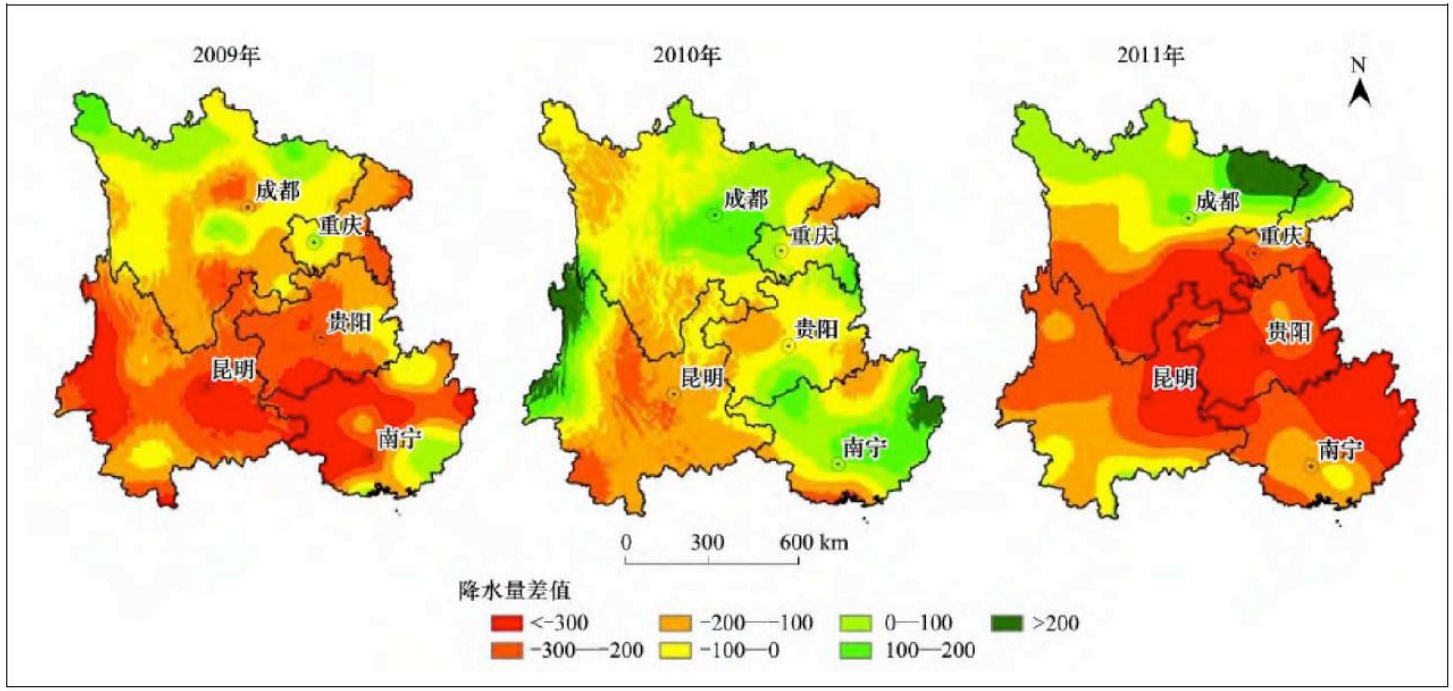
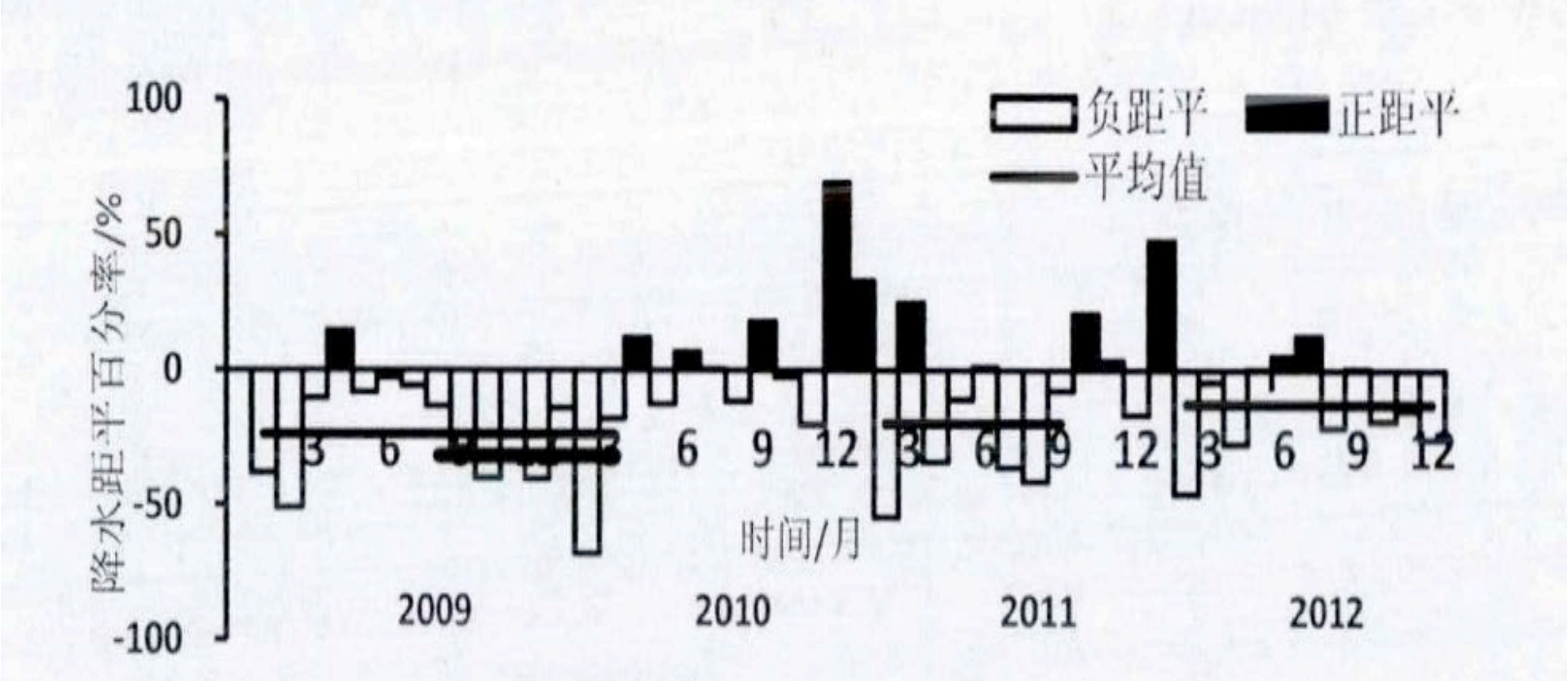



Fig. 16 Precipitation of southwestern China from 2009 to 2011 different from the average of 1980-2011[18]




**Rainfall fluctuation in study region of south China from 2009-2012**

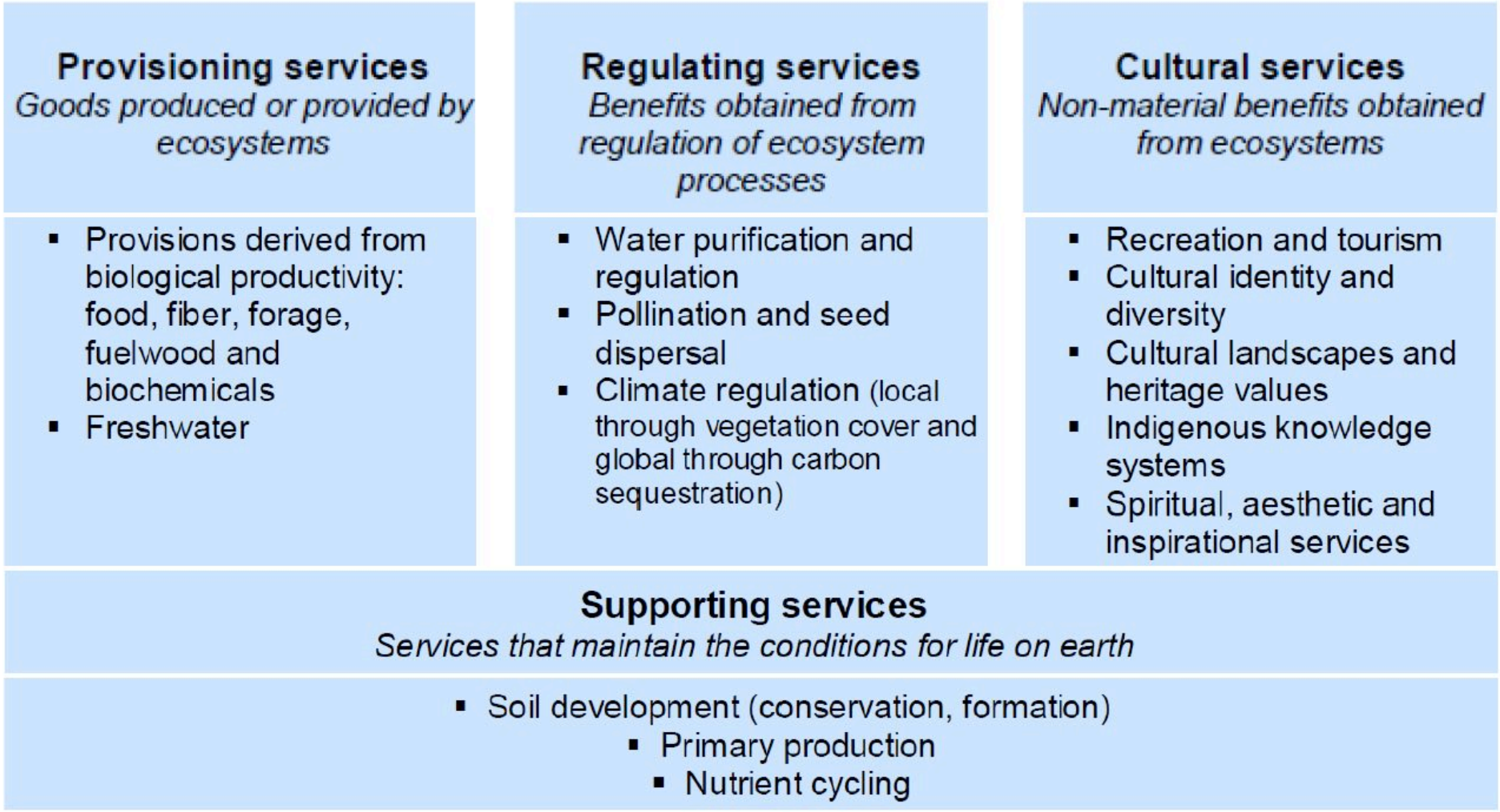



Fig.18 Forest ecosystem service functions

# Impacts of Drought (UN-CSD16-2008)

**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**

## 3.1 The impacts of drought to forest & ecosystem

### 3.1.1 The impacts of drought to forest productivity

Drought will affect tree's growth by reducing **photosynthesis** and health, as well as productivity. By uses GloPEM it found that the average of net primary productivity from 2009-2011 was 12.55 g/cm $^2$/a lower than the average value from 2001-2011. It was 0.017 PgC/a in total. **This reduced China's total carbon sink by 7.91%.** In 2010 alone, this loss reduced China's total carbon sink by 22.33% for that year. NDVI also show that the vegetation in southwest China was remarkably impacted by sustained drought, leading to the ascendant trend. Some investigation show that only in Yunnan Province, the survival rate is lower and about 1/4 of new planted area needed replacement because of drought , and some 10-year old *Zanthoxylum schinifolium* dead.

# 3.1.2 The impacts of droght on Forest Watershed & Hydrology

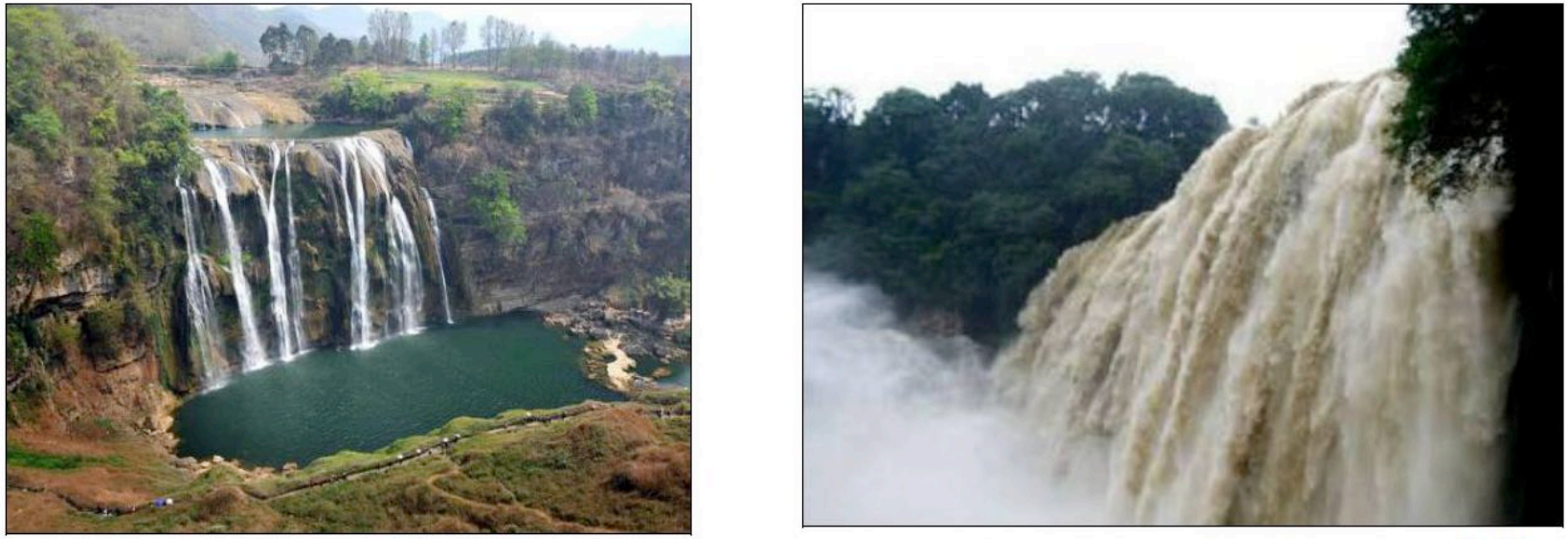


Fig. 19 The famous Huanguoshu fall in drought time and rain season (Guizhou)[25],[26]


Fig. 20 Dry Tourism boats queuing along the dry Lijiang river, Guangxi (March 22, 2010)[27]

### 3.1.3 The impacts of drought to forest fire

Forest fires happened 3737 time in early 2010 from Jan. to March with total fired damaged area of 60,480 ha and caused 26 people dead, which take 63.7% in fire time, 81.3% in fire damaged area and 70% of dead people. Compared with same time in 2009, it increased 47.7% in fire time, 108.6% in fire damaged area and 100% of dead people. Another news from People's Daily said from Feb.1 to March 10, 2010, the forest fire in Guangxi happened 331 time and damaged forest area 6029 ha, increased more than 70% with same time in 2009.

## 3.1.4 The impacts of drought to forest pest

- Drought will affect tree health and growth, as well as **reduce the resistance of tree to plant disesse**. The dry condition may be **helpful for some pests or harmful bacteria** to multiplication. Therefore, drought sometimes also lead to increasement of forest pest and disease in some regions.
- General Station of Forest Pest Management, SFA carried out studies of impacts of drought to forest pest. 4 major forest pest (***Monochamus alternatus, Dendrolimus punctatus, Tomicus piniperda, Parocneria orienta***) have been selected. The results showed that there was positive correlation between the drought level and the occurrence area **of *Dendrolimus punctatus*** in Guizhou, and there was positive correlation between the drought level and the occurrence area of ***Parocneria orienta*** in Sichuan and Chongqing( $P < 0.01$). The influence of drought on forest pests varied from the drought type, drought extent, and the region that was impacted by the drought. In Yunnan Province, the forest pest affacted area increased 71.9% compared with annual average.

## 3.1.5 The impacts of drought to endangerous species (animal/bird/tree)

It has been reported that about 150,00 ha natural reserve had been affected by the drought and large area of wetland disappeared. The bird, ***Grus Nigricollis*** has been almost disappeared because of it's food, the fish had been in short (river dry led) . Large area of ***Cycas panzhihuaensis*** had been died, some migrant left earlly as usually, etc.

## 3.2 Lesson from SW drought for forestry development

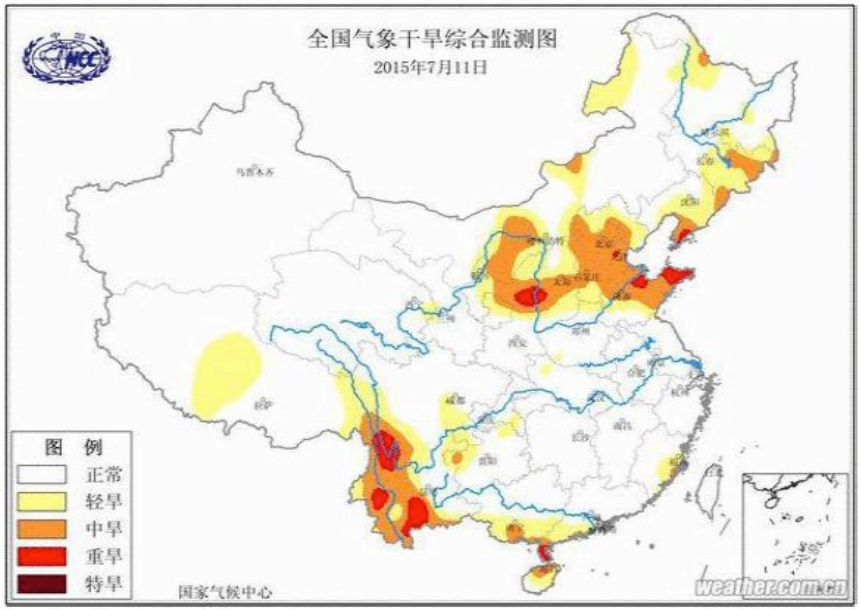
- Mechanism of climate change, especially the drought mechanim;
- The facts climate change and its impacts (case studies);
- Drought monitoring and early warning;
- Studies of the impacts of drought to forest;
- The function of forest in resilience/adaptation/mitigation of climate change;
- Studiy of re-establishment of forest ecosystem;
- Climate resilinent forest management;
- National strategy in combating/anti-drought.
- Sustainable forest mangement measures, both for natural forest management and artificial forest management (tree species selection, anti-drought planting, disease and pest control, etc.)
- Policies and management relation as well as technical studies for sustainable forest management in resilience/adaptation/mitigation of climate change

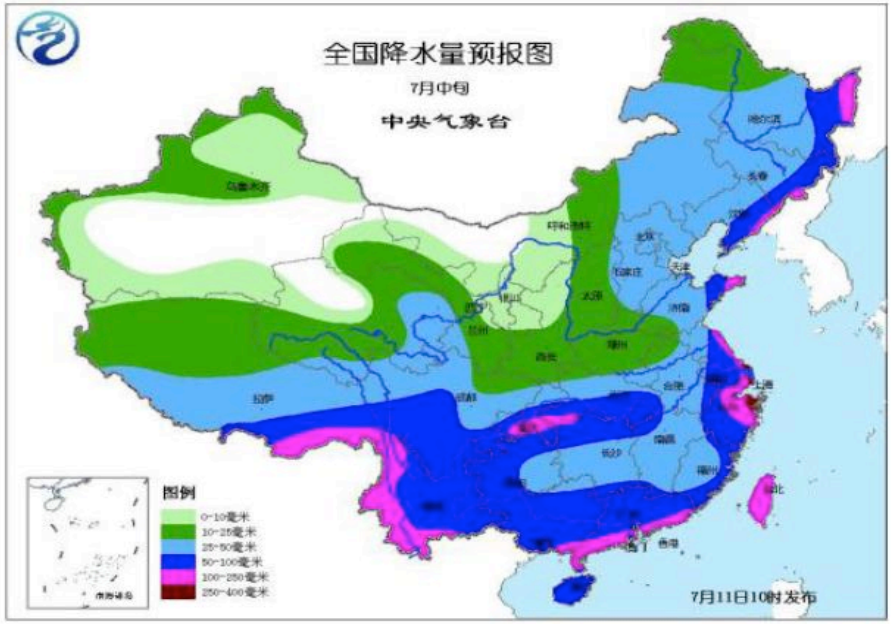
# 4. Lessons learned

- The impacts of drought to forest;
- Drought monitoring, forecasting and early warning;
- Sustainable forest management in resilience drought/climate change (as the doctors himself should be also protected);
- Infrustucture construction for the local people (such water cell for drinking water);
- Treatment of strategy of anti-drought .

## The Government should also:

1) Enhance infrustucture construction for the local people (such water cell for drinking water) to increase anti-drought capacity.
2) Enhance house-hold responsibility policy for collective management forest;
3) National and natural forest protection policy;
4) Subsidy policy for commonweal forest.
5) Perfacting the PES policy.
6) Provide technical assistant to carry out smart forest management;
7) Help the forest farmers in access market;
8) Provide more employment opportunity in reducing the pressure to forest.
9) Rising capacity in resilience and adaptation as well as mitigation climate change



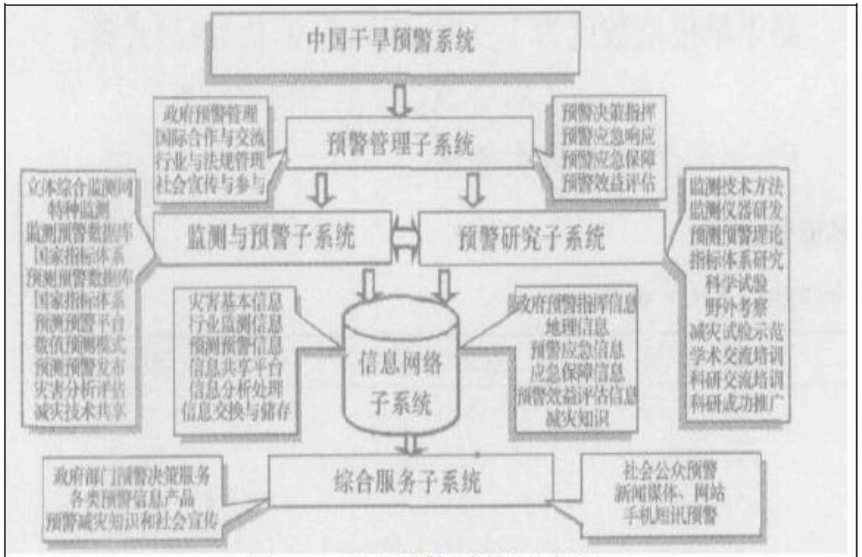



图 2　干旱预警系统示意图


Fig. 22　China Weather Forecasing by Website

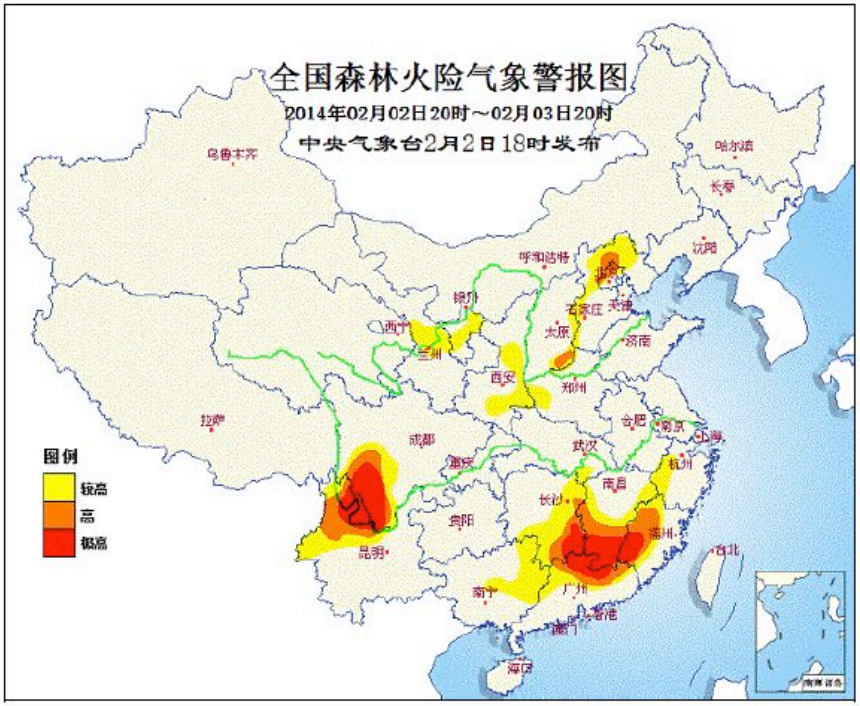




Fig. 26 Forest fire risk forestcasting by CMA and CCTV



Fig. 23 Grassroot Forest Technical Extension Station in China

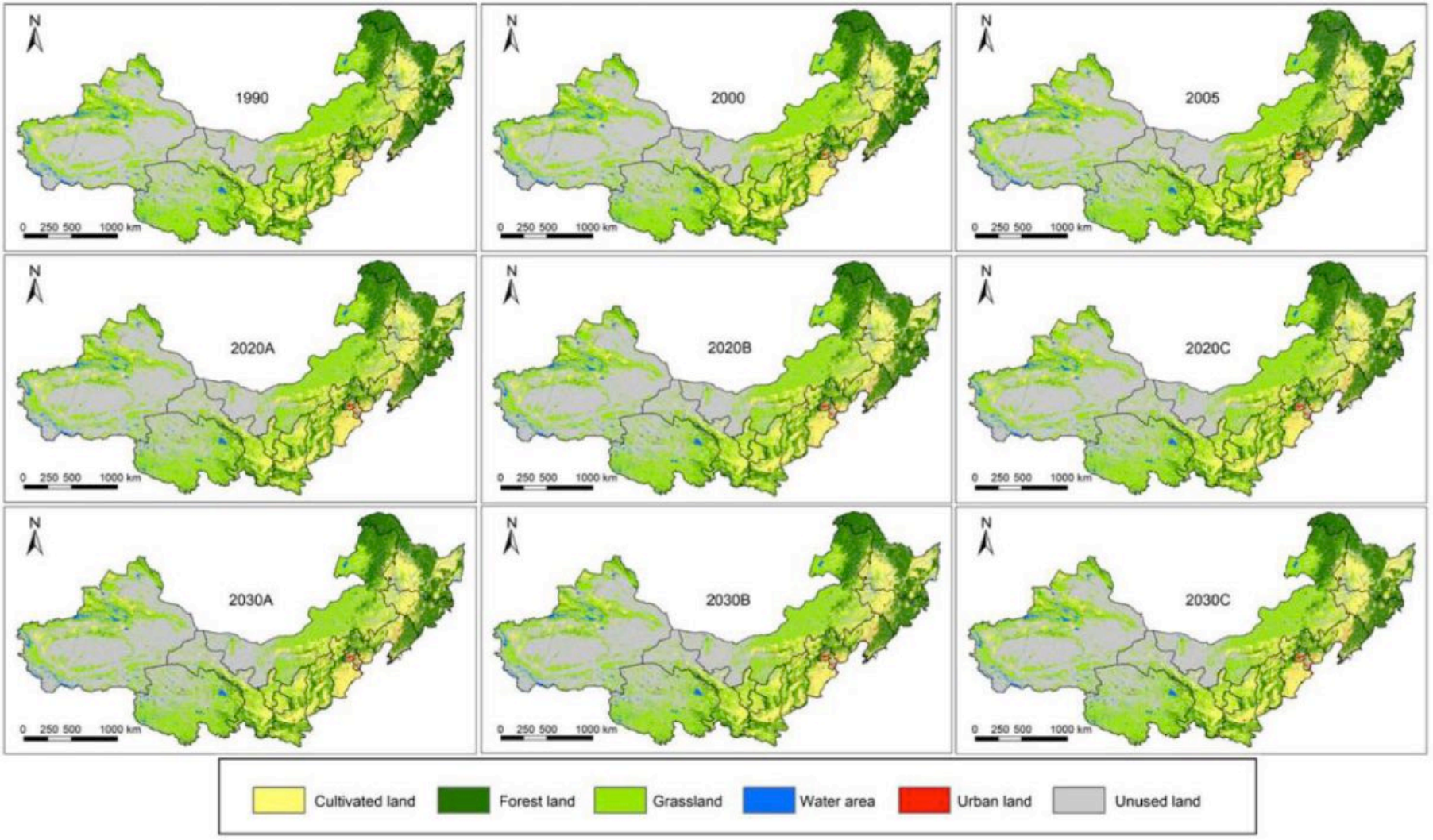



**Figure 7** Historical land use/cover changes from 1995 to 2005 and simulated land use/cover change scenarios (A, B, and C) from 2020 to 2030.

Fig. 24 Drought prediction in north China

# Thank you for your attention