

长城沿线风沙区留茬固土 保护性耕作技术模式研究

**Conservative Tillage for Soil Conservation
with Stubble in Sandstorm Area along the
Great Wall of China**

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中国地形

比例尺

1:26 000 000

0 200 400 600公里

是我国北方四大沙尘暴源区之一

one of the four sources of the sandstorm in northern China.

属农牧过渡区

interlocked of farming and pastoral area

干旱、大风、土地荒漠化、沙尘暴频发的地带

characterized by drought, gust, sandy desertification and frequent sandstorm



报告提纲 Outline of Talk

- 区域概况
- **General survey on the sandstorm area along the Great Wall**
- 研究思路
- **New ways**
- 技术模式
- **Technical mode**
- 技术模式的实践检验
- **Experiments**
- 结论与建议
- **Conclusions and Suggestions**

区域概况

General survey on the sandstorm area along the Great Wall

- 农业资源现状 Agriculture resources
- 自然环境及特点 Nature environment
- 农牧业生产情况
- The production situation of agriculture and stock raising

农业资源现状Agriculture resources

位于我国季风区的西陲

one part of the national western monsoon area

属温带半干旱大陆性气候

semi drought type of the temperate zone

总土地面积**20292.12km²**,
占陕西省土地面积的**9.5%**

The total area of this land is **20292.12km²**, which accounts for **9.5%** of Shaanxi Province,



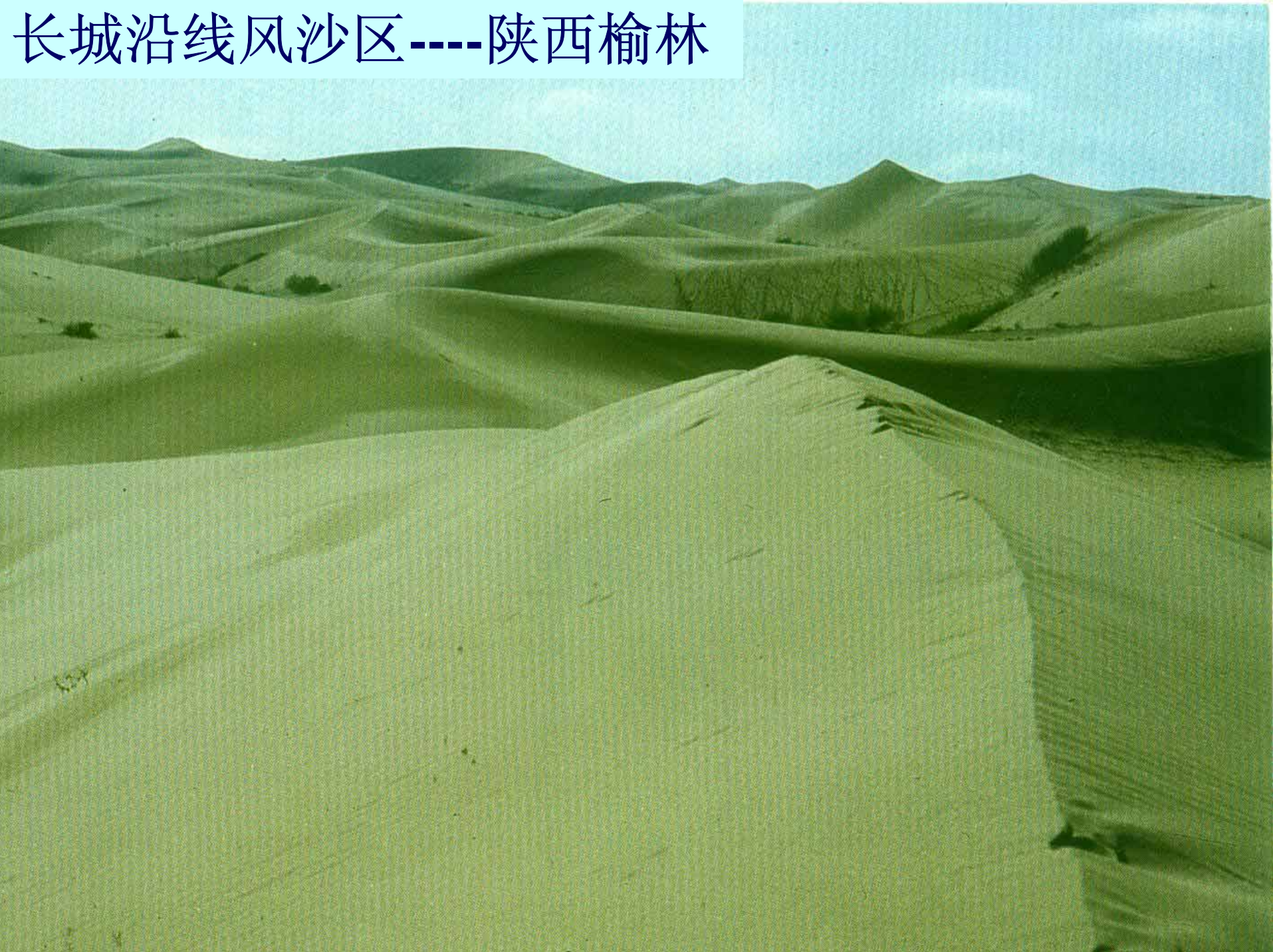
长城沿线风沙区----陕西榆林



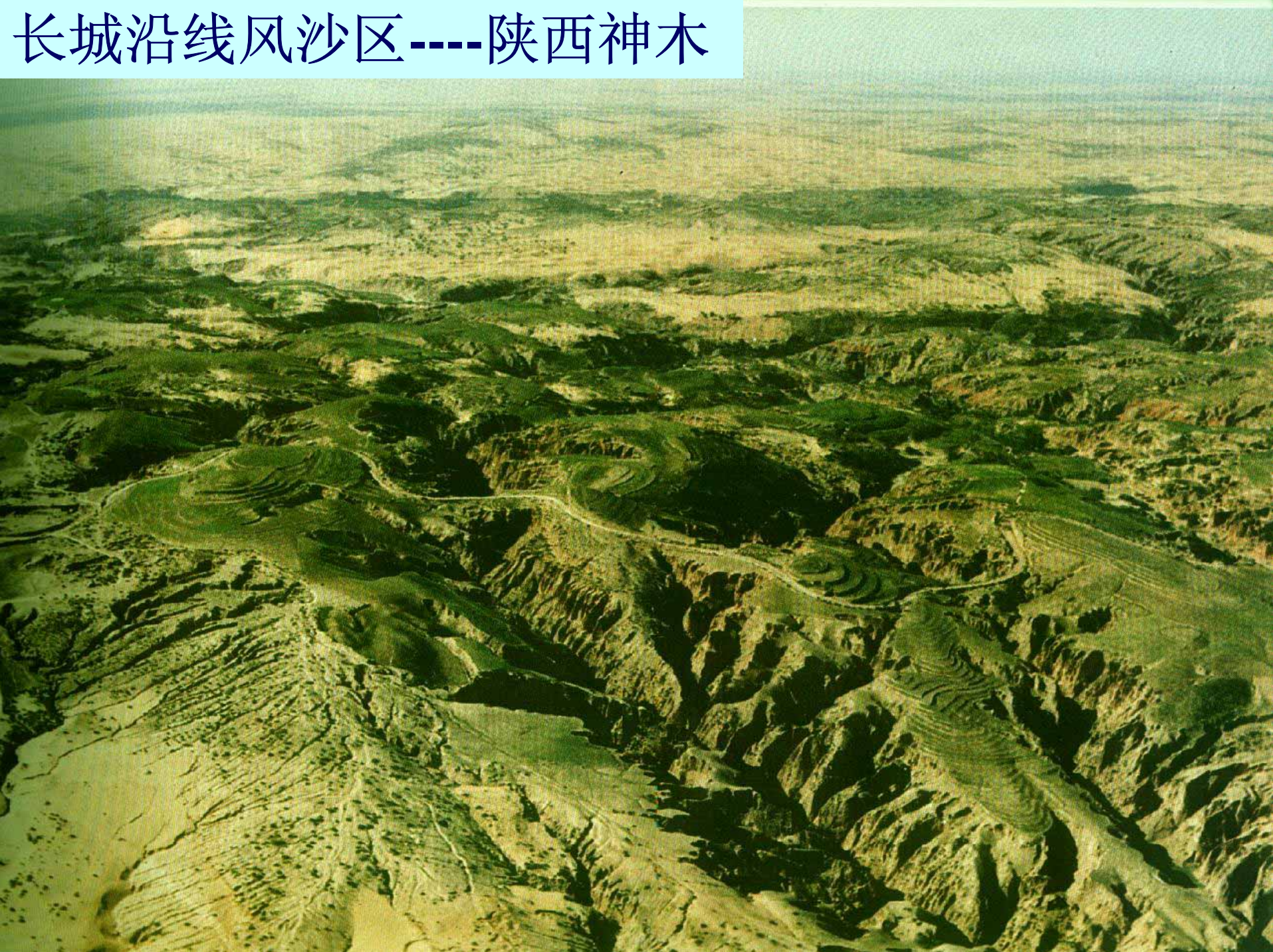
长城沿线风沙区----陕西榆林



长城沿线风沙区----陕西榆林



长城沿线风沙区----陕西神木



长城沿线风沙区----陕西定边

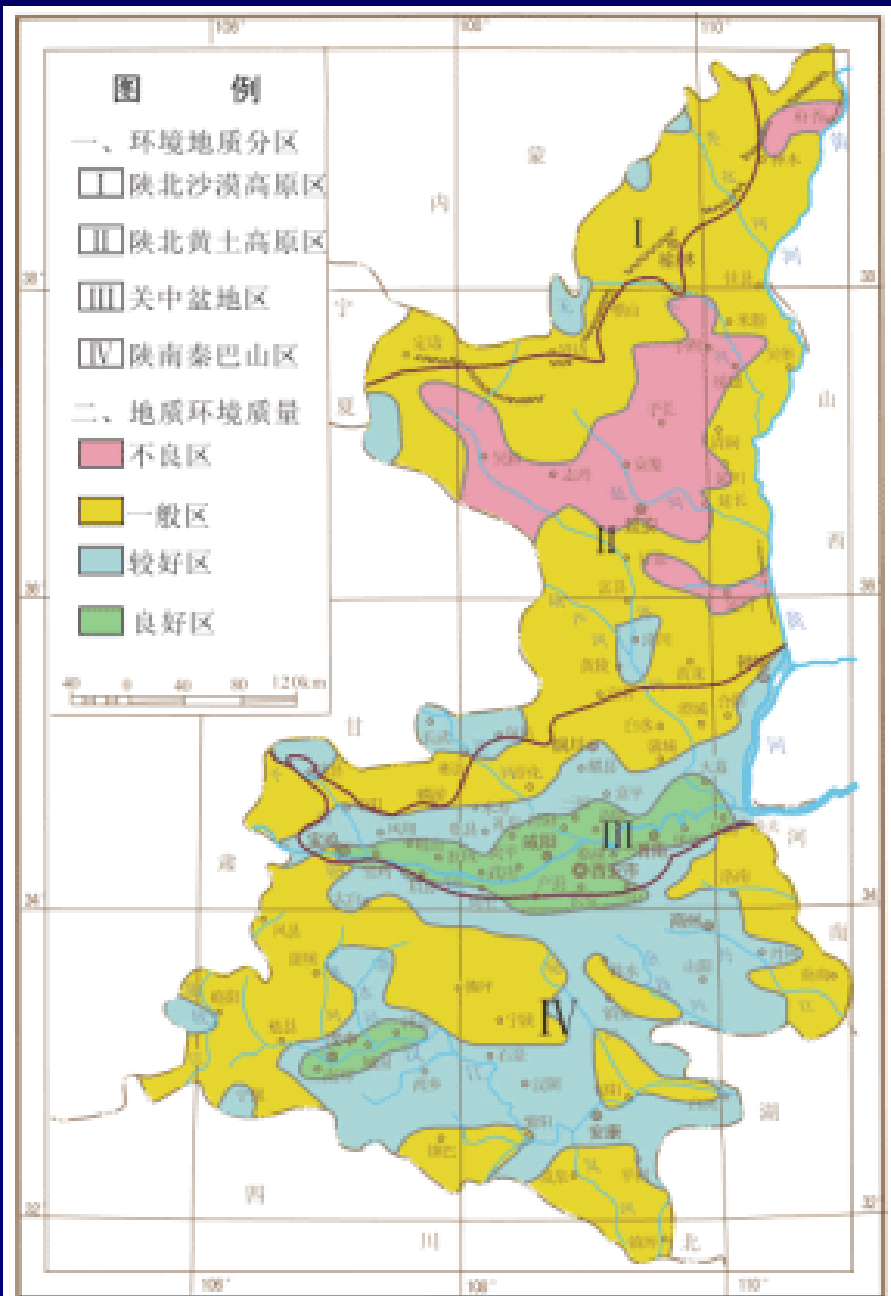


生态环境脆弱，自然灾害频繁，是我国沙漠化扩展严重地区之一。

ecology fragility,
nature disasters
happen frequently,
one of the serious
desertification regions
in China

农业基础薄弱，农业人口比重大。

the weak agriculture
foundation
the high proportion of
agricultural population



陕西省地质环境质量图

图1 陕西省地质环境质量图

自然环境及特点 **Nature environment**

- 土地面积相对广阔，人均占有量较大，人均土地面积**2.11 hm²**;

The area is relatively vast and the per capita of land is high, about 2.11 hm².

- 光能资源丰富，日照充足，光能利用潜力大。

The solar energy is sufficient with enough sunlight, and the potential of solar energy exploitation is huge.

自然环境及特点 **Nature environment**

- 降雨量小，相对变率大，年平均降水量为**316.4—445.0mm**，冬季降水仅占全年的**2~3%**，**7~9月**占全年降水量的**59~76%**；
The rainfall is fewer and varies a lot, and the annual rainfall stands at 316.4—445.0mm. The rainfall in winter accounts for only 2-3% of the total, and 59-76% from July to September.

自然环境及特点 **Nature environment**

- 气温以 6、7、8 三个月较高，雨热基本同季，有利于秋作物和林草生长，但易出现春旱及春夏连旱；

The temperature is high in June, July and August. The rainy and sunny days are almost in the same seasons, which is good for the autumn plants and grasses, but are prone to the continuous drought in early spring and summer.

自然环境及特点 **Nature environment**

- 地表水时空分布不均，地表径流量差异较大，大致趋势是由西南向东北方向递增。The distribution of surface water is not even and the surface runoff varies a lot, with a general increasing trend from southwest to the northeast.

自然环境及特点 **Nature environment**

- 地形平缓，土质松散，透水性强，降水易于下渗、汇集，地下水较为丰富。

The terrain is plain and soil loose, and the water permeability is strong and can easily be seeped down and gathered.

The groundwater is relative rich.

自然环境及特点

Nature environment

- 风蚀沙化严重；
serious wind erosion and soil desertification
- 干旱、暴雨、大风、冰雹、霜冻等自然灾害频繁；
the frequent nature disasters like drought, rainstorm, gust hail and frost
- 农牧业发展压力巨大。
the development of agriculture and stock raising are facing great difficulties.

农牧业生产情况

The production situation of agriculture and stock raising

杂粮

mixed grain



肉羊

the meat
sheep



红枣

Chinese date



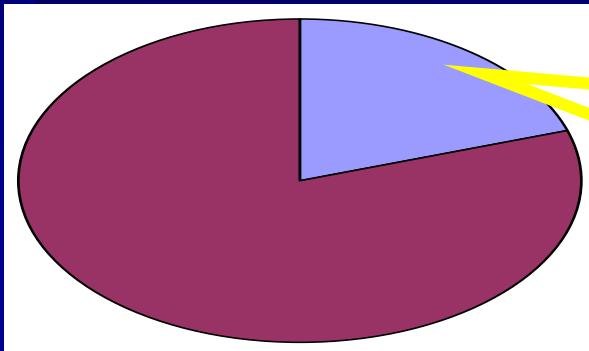
马铃薯

potato



农牧业生产情况

The production situation of agriculture and stock raising



春玉米, **4588hm²** , **25%**

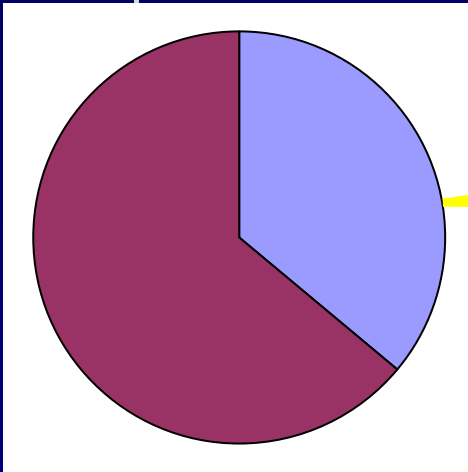
spring corn, 4588hm² ,25% of the
total food plants cultivation area

种植面积

plants cultivation area

农牧业生产情况

The production situation of agriculture and stock raising



春玉米，占36%

spring corn, 36% of total

粮食产量
plants yield

玉米产量的丰歉，直接左右着陕北粮食的总产量。

The abundance and loss of corn decides the total food yield in North Shaanxi.

农牧业生产情况

The production situation of agriculture and stock raising



草地面积**141.74hm²**，以天然草地为主，属于中质低产，管理粗放；
超载率为**20.80%**；

草场肥力低下，牧草产量较低，草场严重退化。

The grassland area amounts **141.74hm²**;

mostly the nature veldt,
poor management

the overstocking rate stands at **20.80%**,

poor fertilization
low yield

further degradation of the veldt.

研究思路

New ways



风沙土

sandstorm soil

土层深厚

土体疏松

渗水透气性好

The soil layer is thick and loose, with good penetration character

扬尘的主要源头；
保土保水保肥能力差；
土壤养分含量低；
抗蚀力较差；

the main source of the duststorm.
a weak capacity in holding water and fertilizer.

The soil is poorly nourished and unable to resist much erosion.

研究思路

New ways

草场肥力低下

牧草产量较低

草场退化

poor fertilization of the land,

low yield of the grass,

degradation of the veldt,



制约畜牧业的发展

**Restrict the
development of
stock raising**

该区域保护性耕作的目标

the goal of conservation tillage in this area

抑制耕地扬尘扬沙

Restrain the dust and sand of soil,

高效利用水资源

Improve high utilization efficiency of water resource,

培肥地力

Nourish the soil,

节本增收

Lower the cost and increase the outcome,

农牧业协调良性发展

a balanced development of agriculture and stock raising.

该区域保护性耕作的思路

the new way of conservation tillage in this area

玉米收获后，
留有一定高
度的根茬

根茬降低农田风蚀，抑制耕地扬沙，固土保墒增产。

收获的玉米秸秆加工成秸秆饲料以缓解牧草不足，促进畜牧业发展。

畜牧业产生的有机肥又可用于改良土壤，培肥地力，实现农牧业协调良性发展。

该区域保护性耕作的思路

the new way of conservation tillage in this area

after the harvest of corn, the stubble with a certain height was preserved

The preserved stubble can resist the wind erosion and restrain the dust, and realize the function of holding the soil humidity and increasing the yield.

The stalk of the harvested corn was transformed into the feedstuff to alleviate the deficiency of pasture and promote the development of stock raising.

The organic fertilizer generated by stock raising can also be used at the enrichment of the soil and further promote the healthy development of agriculture and stock raising.

技术模式

Technical mode

- 第1年：玉米收获——留根茬覆盖休闲——免耕施肥播种——杂草控制——田间管理
- 第2年：玉米收获——留根茬覆盖休闲——错行免耕施肥播种——杂草控制——田间管理
- 第3年：玉米收获——留根茬覆盖休闲——施有机肥——播前地表处理——施肥播种——杂草控制——田间管理

技术模式

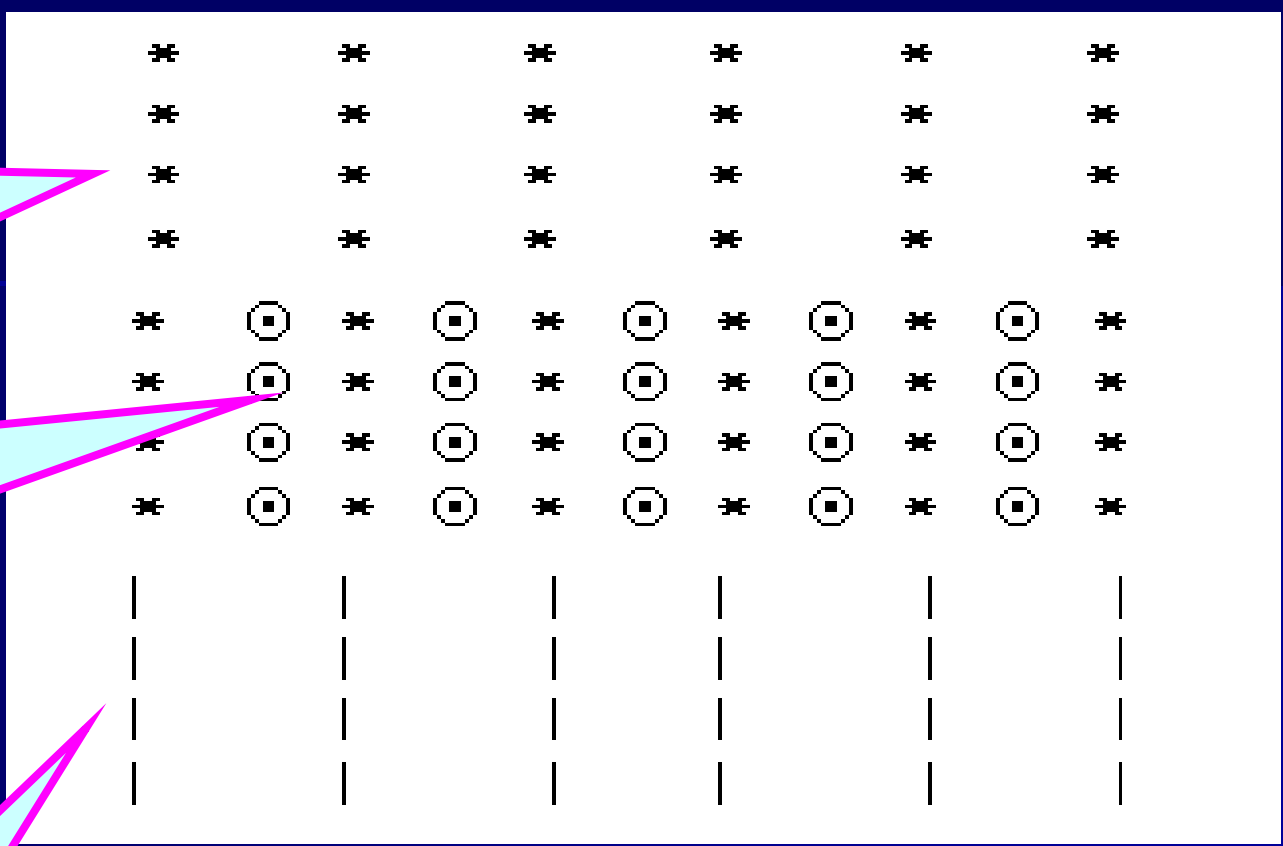
Technical mode

- 1st year: Harvest of corn—stubble reservation for land rest—no tillage fertilization and sow—weed control—field management.
- 2nd year: Harvest of corn—stubble reservation for land rest—row-interval no tillage fertilization and sow—weed control—field management.
- 3rd year: Harvest of corn—stubble reservation for land rest—to fertilize organic fertilizer—to disposal the earth's surface before sowing—fertilize and sow—weed control—field management.

第一年根茬
stubble
reservation of
the 1st year

第二年根茬
stubble
reservation of
the 2nd year

第三年根茬
stubble
reservation of
the 3nd year



留根茬模式图

Fig of Stubble Conservation Mode

模式的技术关键

The key points of this mode

※留根茬残茬覆盖

※错行免耕播种

※播前施肥整地

※杂草及病虫害控制

※ stubble reservation,

※ row-interval no tillage,

※ to disposal the earth's surface before sowing,

※ weed control and field management.

留茬覆盖技术

Remain stubble to cover soil technology

玉米收获后，留茬高度
不少于**20cm**；

冬季休闲期，对表土不
做任何处理。

After the corn stalk is
harvested, remained
stubble, whose height
should be less than 20cm.

Nothing is done to the
surface of fallow land.



错行免耕播种

row-interval no tillage

第2年采用免耕播种机
直接在留茬地表进行
施肥免耕播种；

In the first year, no tillage
fertilizing sowing is done
to the surface of remained
stubble land by no tillage
sowing machine directly.



第2年在留茬行间进行施肥免耕播种

In the next year, no tillage fertilizing and sowing is done to the inter-row space.



错行免耕播种

row-interval no tillage

第1年的根茬

1st year Remained stubble

第2年的根茬

2nd year Remained stubble



播前施肥整地或用旋耕播种联合作业

disposal the earth's surface before sowing
or teamwork of rotary tillage and sowing

第3年在玉米播前施入农家肥，播前用旋耕机进行浅旋，用免耕播种机施肥播种。浅旋作业深度 $<10\text{cm}$ 为宜，浅旋作业在播种前2~3天为好。

In the third year, farm manure is fertilized before sowing corn seed.

Shallow rotary tillage is done before seeding. Fertilization and seeding are done by no tillage sowing machine.

The appropriate rated depth of shallow rotary tillage is 10cm. Shallow rotary tillage should be finished in 2-3 days before tillage



杂草及病虫害控制

weed control and field management

在免耕播种之后应及时进行土壤封闭处理，并配合茎叶处理等不同施药方法，控制病虫害。

Some measures should be done after no tillage sowing in time, and spray pesticide to stems and leaves to control weed, plant diseases and insect pests.

实践检验 Experiments

试验时间： 2004~2006

试验地点： 恒山县横山镇大古界村

试验面积： **5.3hm²**

Time : 2004~2006

Site: Dagujie Village, Hengshan Town, hengshan county

Area: **5.3hm²**

试验结果及分析

Results and discussion

产 量

Yields

经济效益

Economic efficiency

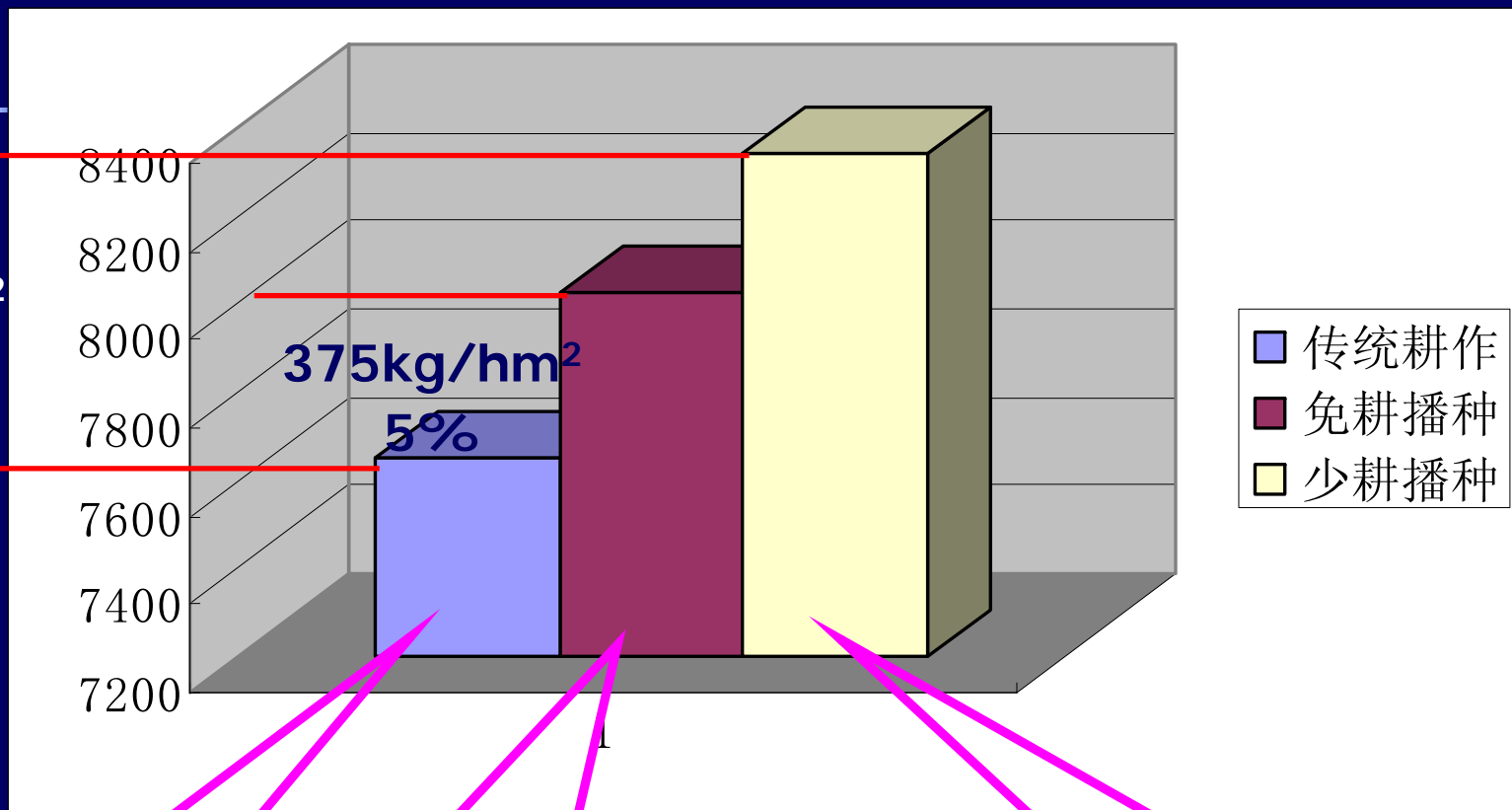
生态效益

Ecological benefits

社会效益

Social benefits

产量 Yields (kg/hm²)



690
kg/hm²
9%

传统耕作的平均值
Average yield of
traditional tillage

第1、2年的平均值
Average yield of
1st and 2rd years

第3年的产量
The yield of 3rd year

经济效益

Economic efficiency

项 目 (元/hm ²)	传统耕作	保护性耕作	节本增收
机耕费用	750	450	300
灌溉费用	1350	900	450
玉米良种	225	112.5	112.5
玉米增收	9945	10637.25	692.25
合 计			1554.75

Economic efficiency

Items (RMB/hm²)	Traditional tillage	Conservative tillage	Cost saved or income increased
Tractor plowing cost	750	450	300
Irrigation cost	1350	900	450
High-quality corn seeds fee	2259	112.5	112.5
Increased corn yield benefit	945	10637.25	692.25
Total			1554.75

生态效益 Ecological efficiency

1.减少农田风蚀，抑制扬沙、扬尘。

decreased wind erosion to farmland and controlled sand and dust emission.

2.提高了土壤的蓄水保墒能力，减少了灌溉用水量。

improve water storing and moisture preserving ability of soil, and decrease irrigation water used.

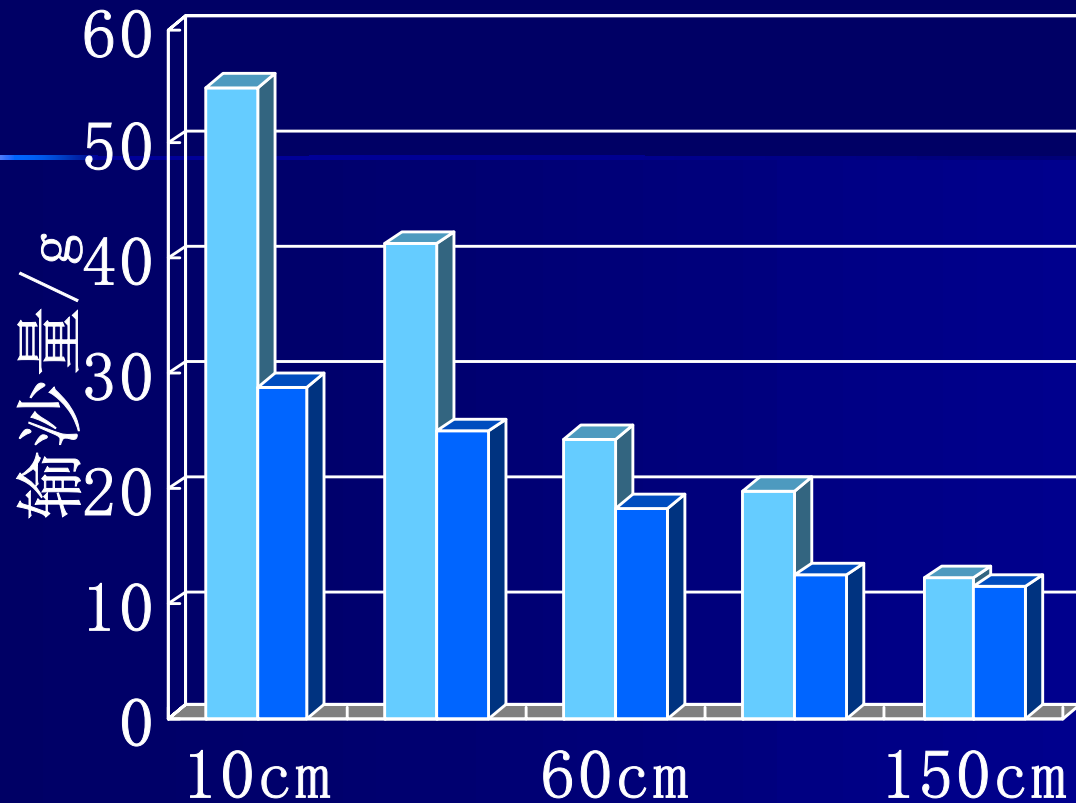
3.改善了土壤结构，培肥地力，土壤有机质含量平均每年提高0.03~0.06%。

improved soil structure and fertility. The content of soil organic matter can be increased by 0.03~0.06% per year.

1.减少农田风蚀，抑制扬沙、扬尘。 decreased wind erosion to farmland and controlled sand and dust emission.

序 号	高 度/cm	输沙量/g	
		传统耕作	保护性耕作
1	10	55.0	28.9
2	25	41.3	25.0
3	60	24.4	18.3
4	100	19.9	12.5
5	150	12.2	11.5
合 计		152.8	96.2

各高度层总输沙量

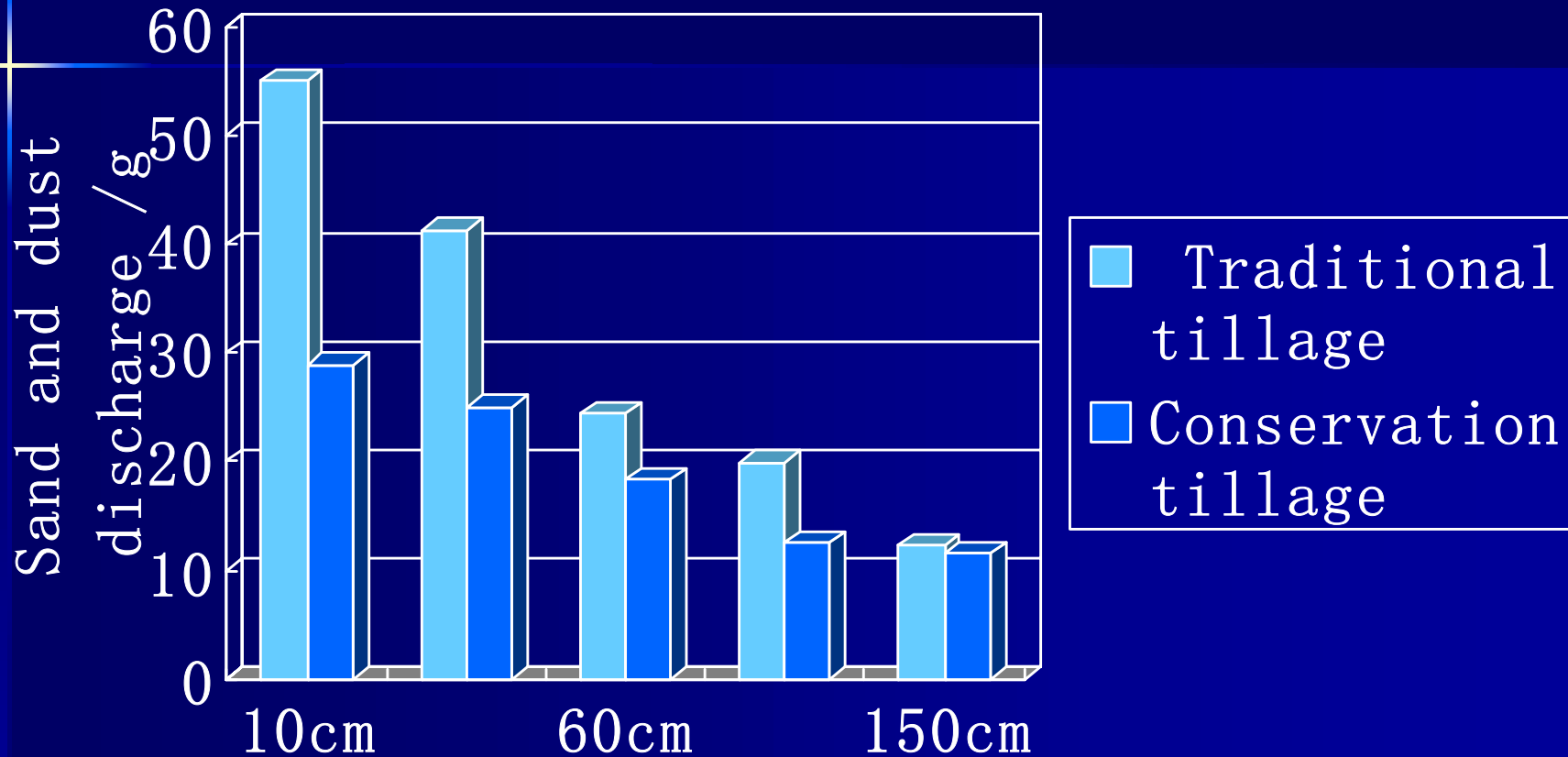


■ 传统耕作
■ 保护性耕作

集沙仪入风口距地表高度

单位面积上根茬数较多，根茬起到了很好的防风固沙作用。

Total sand and dust discharge in each height

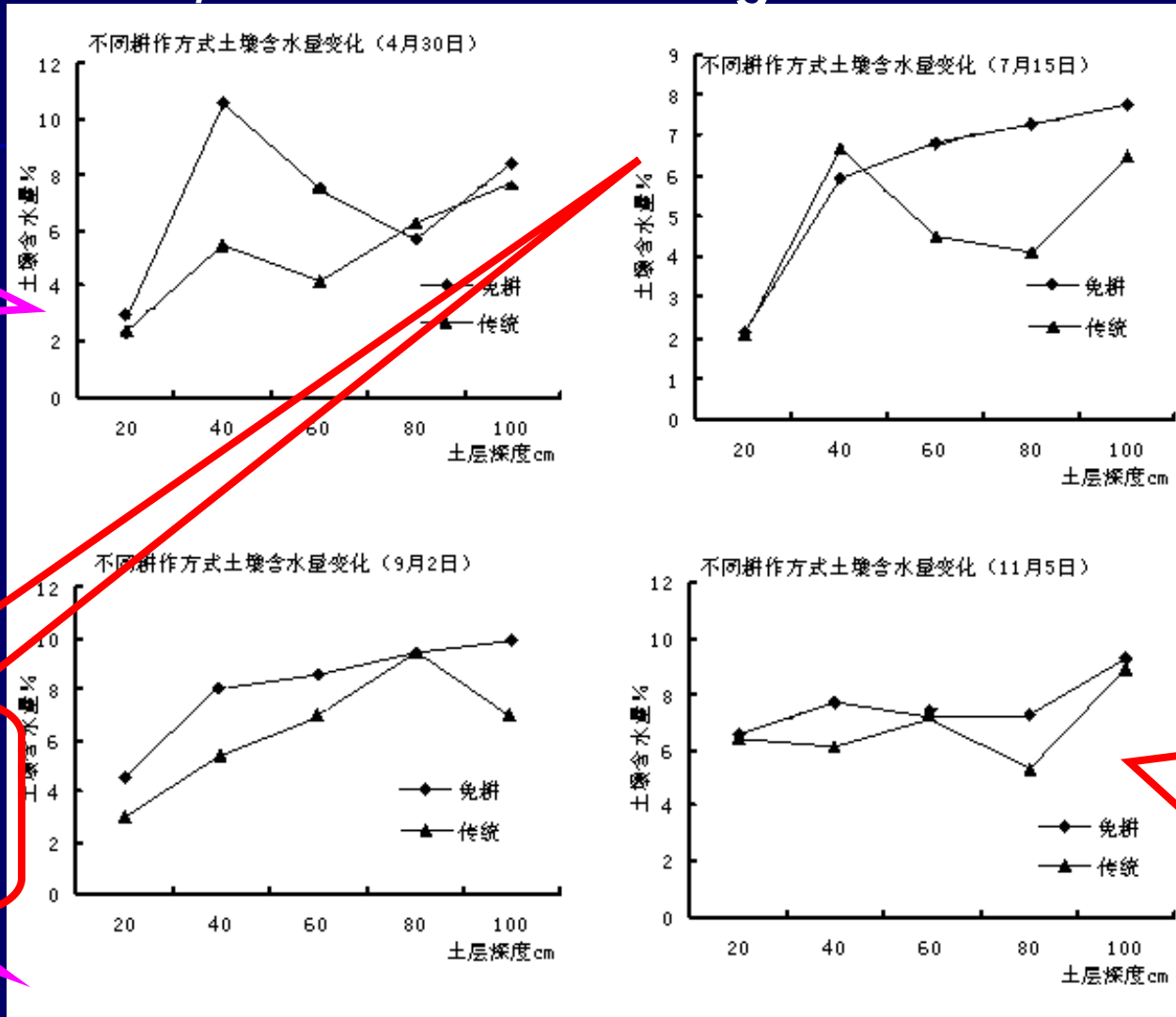


More stubbles and roots in per unit area, better control of wind and solidification of sand.

2. 提高了土壤的蓄水保墒能力, 减少了灌溉用水量。

improve water storing and moisture preserving ability of soil, and decrease irrigation water used.

播种期
seedtime



生长期
Growth
time

收获期
Harvest
time

The soil moisture at different layers with different tillage modes

土壤蓄水保墒能力



the soil conservation moisture ability

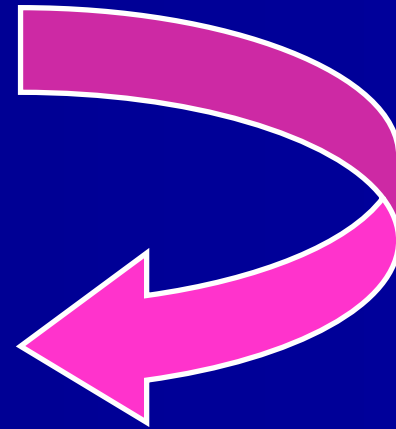
土壤含水量



the soil moisture

减少了灌溉次数和灌溉水的用量，

每年可节水1800 m³/ hm² 。



The frequency and quantity of irrigation has been reduced.
Under conservation tillage it can save water by 1800 m³/ hm²
per year.

春季浇灌降低土壤温度，而保护性耕作不春灌，早春土壤温度回升快，能够满足玉米对积温的需求，使生育期长、增产潜力大的玉米品种得到正常成熟。

Under conservation tillage, soil temperature in spring would raise quickly without irrigation. It satisfied the requirements of maize for heat and insured normal growth of some maize varieties with long growth stage and high yield potential.

**3.改善了土壤结构，培肥地力，
土壤有机质含量平均每年提高0.03~0.06%。**

improved soil structure and fertility.

**The content of soil organic matter can be
increased by 0.03~0.06% per year.**

由于留根茬数多，使冬季降雪和植株的残枝落叶不易被风吹走，既增加了土壤有机质含量，又增加了休闲期土壤贮水量和水分利用率。

**Because of residue-stubble, snowfall in winter
and defoliation of plant were not easily blowed
away. It not only increased the soil organic
matter but also improved soil moisture content
and water use efficiency.**

社会效益

Social benefits

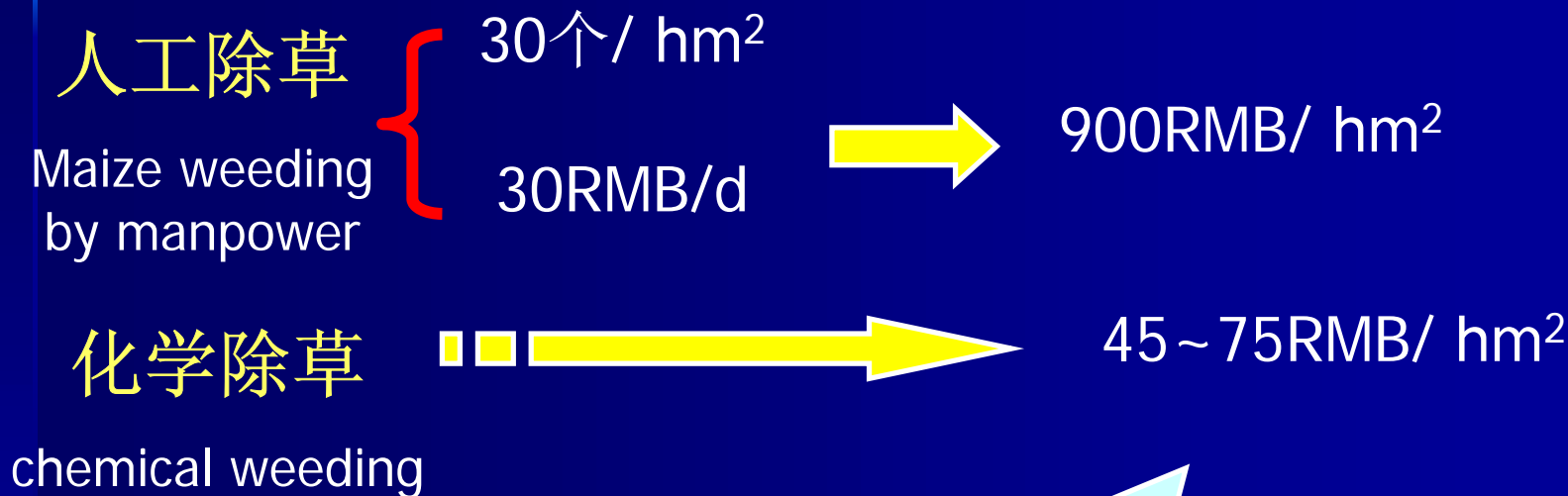
保护性耕作实施先进农业技术，提高了劳动效率，减轻了劳动强度，有效地解放和节约了农村劳动力，使剩余劳动力向第二、三产业转移。

The advanced production technology with conservation tillage can save time, reduce labors used at the busy sowing and harvest stage, lighten labor strength, liberate labor force in rural area, and absorb labors from the second and third industry.

社会效益 Social benefits

促进了化学除草的广泛应用。

accelerates the widely application of chemical weeding.



节约: 825 ~ 855RMB/hm²
Saved cost

社会效益 Social benefits

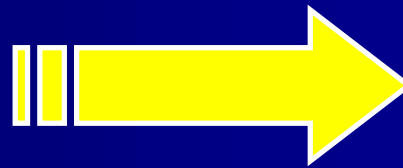
保障和带动了畜牧业的发展

ensured and promoted the improvement of stockbreeding.

15000kg/ hm²

单位面积玉米秸秆产量

the yield of maize stalk



75

舍饲养羊

Number of sheep

can feed

促进畜牧业的良性发展

benign development of stockbreeding

结论与建议

Conclusions and Suggestions

1. 保土、保墒、保肥； soil, water and fertility conservation
2. 省工、省力、省能； time, labor and energy saving
3. 增产、增效、增收的效果；
yield, efficiency and income increasing
4. 生态环境的改善； environment improvement
5. 抑制扬风扬沙。 wind erosion reduction.

存在的问题

problem

土质较为坚实

the hard soil

玉米根茬较大

big maize stubble



现有的免耕播种机在耕作过程中存在下种难或堵塞等问题，应进一步改进，提高其性能。

No tillage sowing-machine have some problems such as difficulty to sow and easily to jam etc during no tillage sowing operation.

It should be resolved as soon as possible to improve its performance in the future.

谢谢!

Thanks