Research and Application of JUNCAO Technology
菌草技术研究与应用

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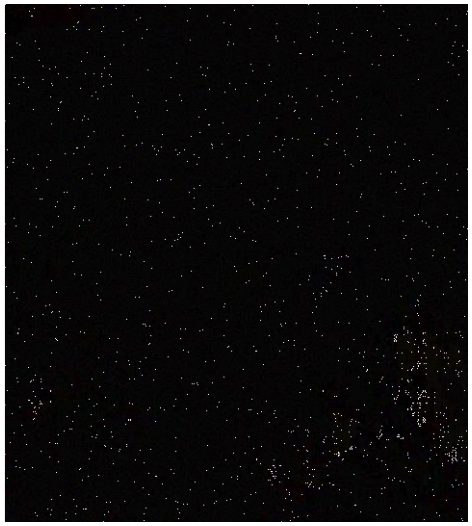
1 Emerging JUNCAO Industry

一、新兴产业—菌草业

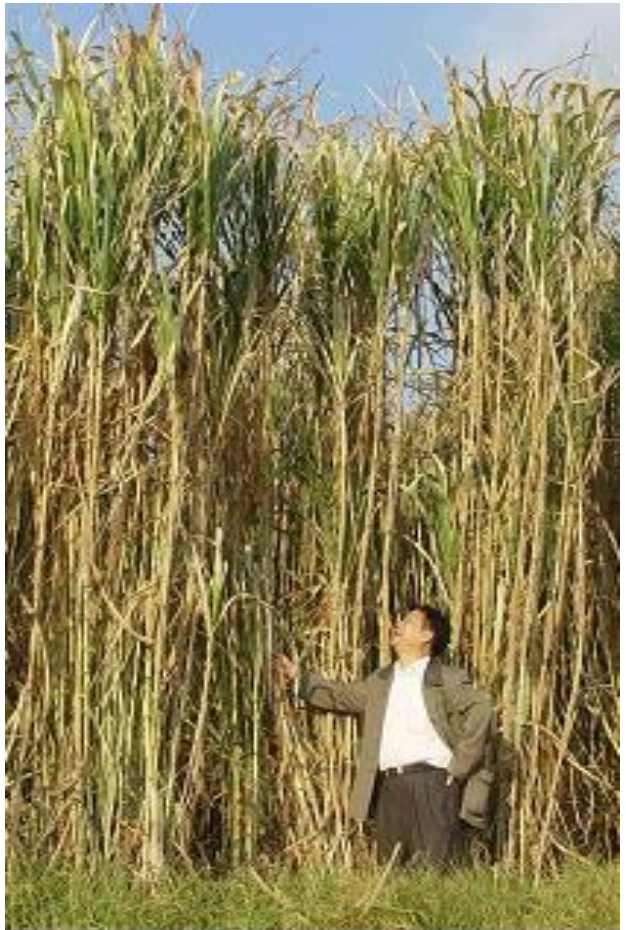


1.1 JUNCAO, JUNCAO Technology and JUNCAO Industry
菌草、菌草技术及菌草业

JUN: fungus CAO: grass

- **The rapid development of *Xianggu, Auricularia, Ganoderma* and other edible and medicinal fungi led to conflicts between mushroom production & forest protection had become increasingly prominent.**
- **香菇、木耳、灵芝等食药用菌的快速发展导致“菌林矛盾”日益突出。**

- **Research on Juncao technology started in 1983, and firstly succeed in 1986.**
- **1983年，开展了“以草代木”栽培食药用菌的研究，1986年获得成功，发明了菌草技术。**



The origin of JUNCAO technology 菌草技术由来

Mushroom production – short cycle, low investment, high profit

Traditional cultivation method utilizing wood logs

食药用菌生产：周期短，投入低，效益高

传统栽培方法：段木栽培

The origin of JUNCAO technology 菌草技术由来

Since 1970s，wood logs and sawdust became conventional raw material for cultivating substrates of *Lentinula edodes*、*Auricularia polytricha and Ganoderma lucidum*

19世纪70年代，香菇、木耳、灵芝等栽培以段木或木为主要栽培原料

- **"JUNCAO industry International Symposium" held in Fuzhou November 1996 and held in South Africa November 2006, Under the auspices of the Professor Zhang Shuting who is internationally renowned mushroom scientists，giving the definitions of JUNCAO, JUNCAO Technology, JUNCAO Industry.**

- **1996年11月在福州和2006年11月在南非召开的“菌草业发展国际研讨会”，在国际著名蕈菌学家张树庭教授的主持下为菌草、菌草技术、菌草业作出定义。**

- **JUNCAO:**
  Herbaceous plant that can be used as the culture substrate for cultivation of edible and medicinal fungi.
- **JUNCAO Technique:**
  Techniques that use JUNCAO to cultivate edible and medicinal fungi and produce mushroom protein forage.
- **JUNCAOIndustry:**
  Industry formed by using of JUNCAO technique and some other interrelated techniques.

- 菌草：可作为栽培食用菌、药用菌培养基的草本植物统称菌草；
- 菌草技术：运用菌草栽培食用菌、药用菌和生产菌物饲料、菌物肥料的综合技术简称菌草技术；
- 菌草业：运用菌草技术及相关技术形成的产业简称菌草业。

1.2 Achievements 主要成果

1.2.1 JUNCAO varieties selection and artificial cultivation techniques

菌草品种筛选及人工栽培技术

- Establish tertiary system screening method
- 46 species of fine Juncao grasses screened and bred
- R&D of tissue culture, cultivation, harvesting, processing technology

- ✓ 建立三级系统筛选法
- ✓ 筛选出菌草品种46种
- ✓ 研发组培、种植、收割、加工工艺。


Wild 野生菌草芒萁
Dicranopteris dichotoma


Artificial 人工栽培
Pennisetum giganteum z.x.lin

1.2.1 46 herbaceous plant species selected

筛选出46种适合于菌类生长的主要菌草品种

Family 科	Genus 属	Species 种
Gramineae 禾本科	Pennisetum 狼尾草属	象草（*P. purpureum* Schumach）；皇竹草（*P. sinese* Roxb.）；杂交狼尾草（*P. americanum*´*P. purpureum*）；巨菌草（*P.* sp.）
	Phragmites 芦苇属	芦苇（*P. communis* Trin.）
	Neyraudia 类芦属	类芦（*N. reynaudiana* (Kunth) Keng）
	Miscanthus 芒属	五节芒（*M. floridulus* (Lab.) Warb. ex Schum et Laut.）；荻（*M. sacchariflorus* (Maxim.) Benth.）；芒（*M. sinensis* Anderss）
	Saccharum 甘蔗属	斑茅（*S. arundinaceum* Retz.）；彼特草（*S. robustum* Brand et Jeswiet）
	…	
Leguminosae 豆科	Medicago 苜蓿属	紫花苜蓿（*M. sativa* L.）
	Stylosanthes 柱花草属	柱花草（*S. guianensis* (Aubl.) Sw）
Gleicheniaceae 里白科	Dicranopteris 芒萁属	芒萁（*D. dichotoma* (Thunb.) Bernh.）；大芒萁（*D. ampla* Ching et Chiu）
…		

Part of the commonly used JUNCAO
部分常用的菌草

Part of the commonly used JUNCAO
部分常用的菌草

➢Study on JUNCAO rapid propagation technology

Eight kinds of grass tissue culture nursery technology were established, such as *Pennisetum giganteum* z.x.lin, *Arundo donax* L. Formed a complete system of tissue culture and rapid propagation technology cutting of JunCao explant induction, proliferation, transplantation and in vitro preservation, etc.

➢菌草快繁技术研究

分别开展建立了巨菌草、芦竹等8种菌草组织培养育苗技术研究，形成了菌草外植体诱导、增殖、瓶苗移植及离体保存等完整的组培和扦插快繁技术体系。

JUNCAO planting, irrigation and fertilization, harvesting, milling
种植（人工、机械）、灌溉施肥、收割（人工、机械）、粉碎

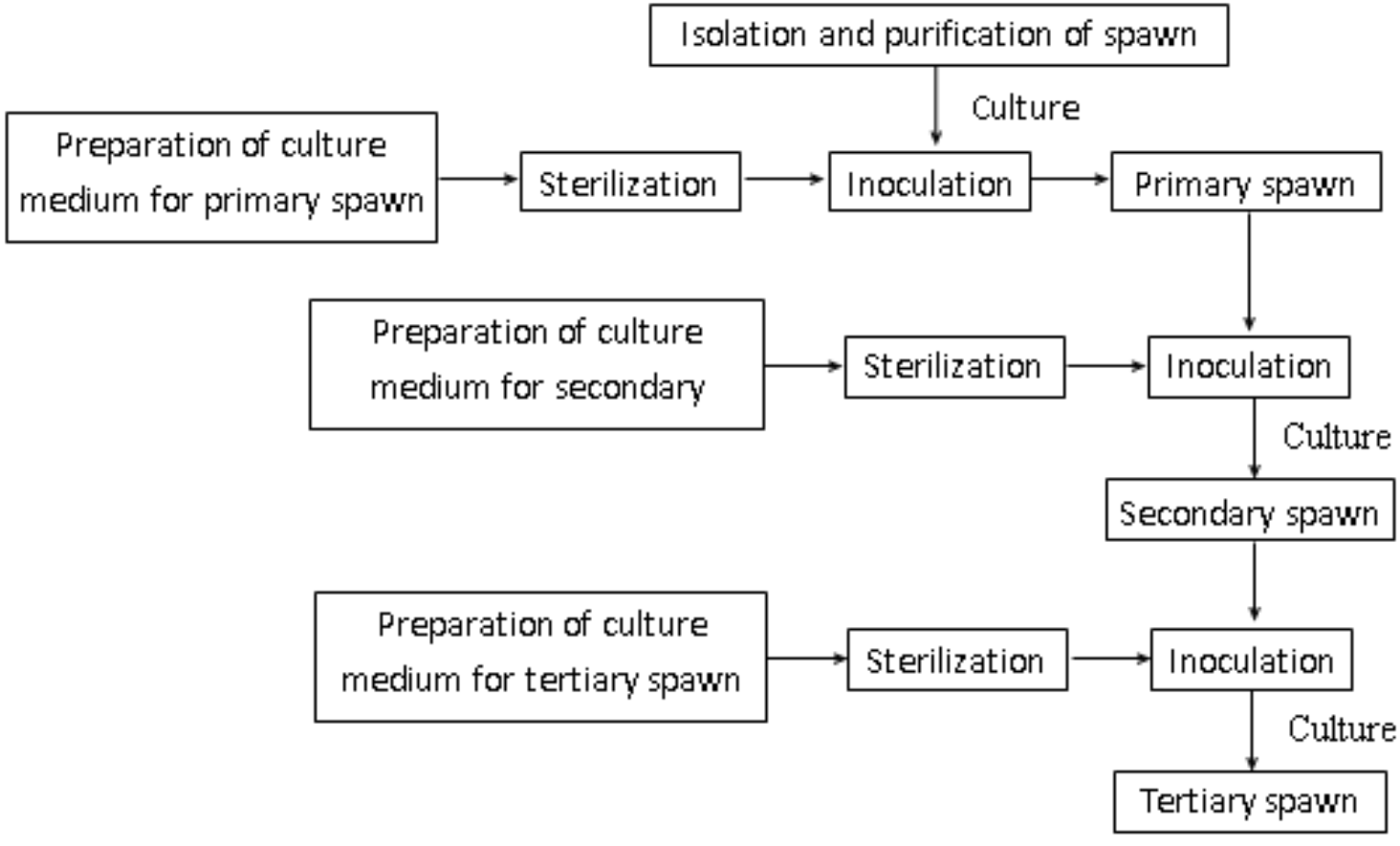
1.2.2 54 mushroom species cultivated with JUNCAO

筛选出54种适合于菌草栽培的主要菌类品种

Family 科	Genus 属	Species 种
Agaricaceae 蘑菇科	*Agaricus* 蘑菇属	双孢蘑菇（*A. bisporus*）；巴西蘑菇（*A. blazei Murill*）
Phallaceae 鬼伞科	*Coprinus* 鬼伞属	毛头鬼伞（鸡腿菇）（*C. comatus*）
Coprinaceae 鬼笔菌科	*Dictyophora* 竹荪属	长裙竹荪(*D. indusiata*)；红托竹荪(*D. rubrovalvata*)；短裙竹荪(*D. duplicata*)
Pleurotaceae 侧耳科	*Pleurotus* 侧耳属	平菇(*P. ostreatus*)；紫孢侧耳(*P. Sapidus*)；粉红平菇(*P. rhodophyllus*)；凤尾菇(*P. pulmonarius*)；金顶侧耳(*P. citrinipileatus*)；盖囊侧耳(*P. cystidiosus*)；阿魏蘑(*P. ferulae*)；鲍鱼菇(*P. abalonus*)；杏鲍菇（*P. eryngii*）
Strophariaceae 光柄菇科	*Volvariella* 草菇属	草菇（*V. volracea*）
Pluteaceae 粪伞菌科	*Agrocybe* 田头菇属	柱状田头菇(*A. cylindracea*)
Hericiaceae 猴头菌科	*Hericium* 猴头菌属	猴头菇(*H. erinaceus*)
…		

Edible and medicinal mushrooms cultivated with JUNCAO

部分菌草栽培食、药用菌



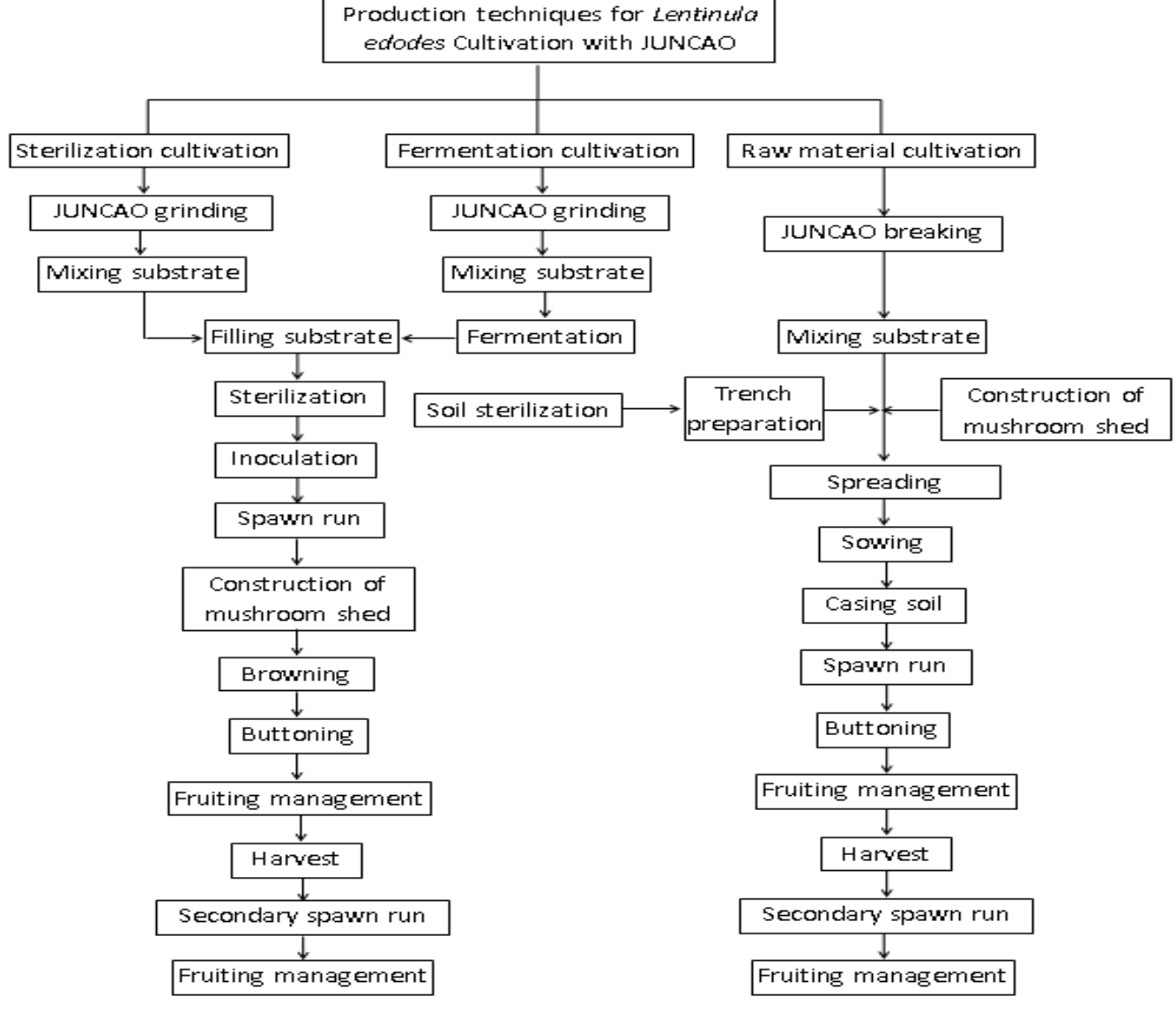
Brief Procedures of Spawn Production

菌种生产工艺

Production Techniques of Edible and Medicinal mushroom Cultivation with JUNCAO e.g.:*Lentinula edodes*

菌草栽培食药用菌生产技术

（以香菇为例）



Production Techniques of *Lentinula edodes* Cultivation with JUNCAO

1.2.3 Sustainable ecological protection models

建立可持续的生态治理模式

Soil erosion　　Desertification　　Desert Sand

JUNCAO used for desertification control

已用于治沙的菌草

Planting Juncao to control soil erosion and desertification

菌草技术治理水土流失、沙化

Planting giant Juncao in desert of Yongning County in Ningxia ,

producing fresh grass 225～300 tons/ha

宁夏永宁县荒漠地种植巨菌草年产鲜草可达225～300吨/公顷

Tibet, Inner Mongolia Plant JUNCAO to Control Desertification

西藏、内蒙古种植菌草治理流动沙丘

Collapsed hills management
Changting, Fujian,
菌草治理崩岗 - 福建长汀

Demonstration Juncao interplanting with crops at contours in Rwanda

援卢旺达农业技术示范中心菌草等高线活篱笆套种作物

planting local crop (potato, maize)

planting Juncao

Soil erosion control experiment zones

RATDC, Butare, Rwanda

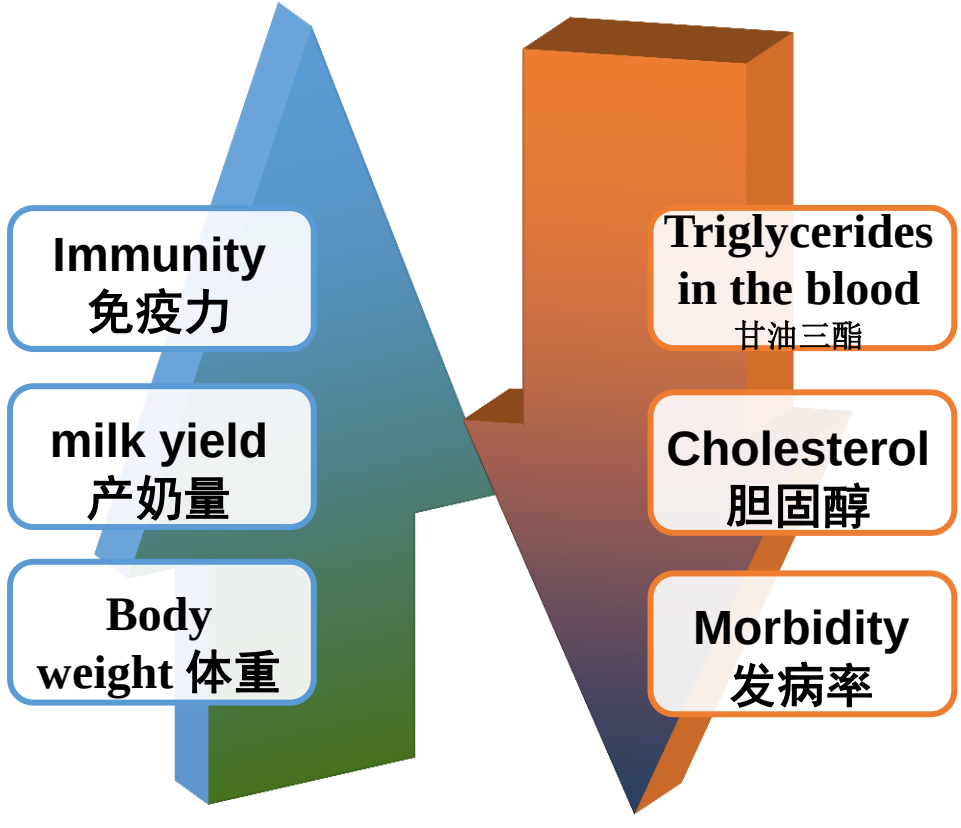
卢旺达水土流失治理 不同处理的对比

Highland areas of degraded grassland JUNCAO cropping patterns - Lesotho - Maseru

高原地区退化草地菌草种植模式--莱索托-马赛卢高原

1.2.4 Juncao Fodder & Spent Substrate Forage 菌草饲料及饲料添加剂

Extracts of JUNCAO spent *Ganoderma lucidum* substrate can be used as feed additives
菌草灵芝菌糟提取物做饲料添加剂



According to the technical specification for healthy food inspection and evaluation (2003), extracts of JUNCAO spent Ganoderma lucidum substrate can enhance immunity function

菌草灵芝菌糟提取物具有增强免疫力功能。

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Experiment of JUNCAO *Ganoderma lucidum* residue

菌草灵芝菌糟实验

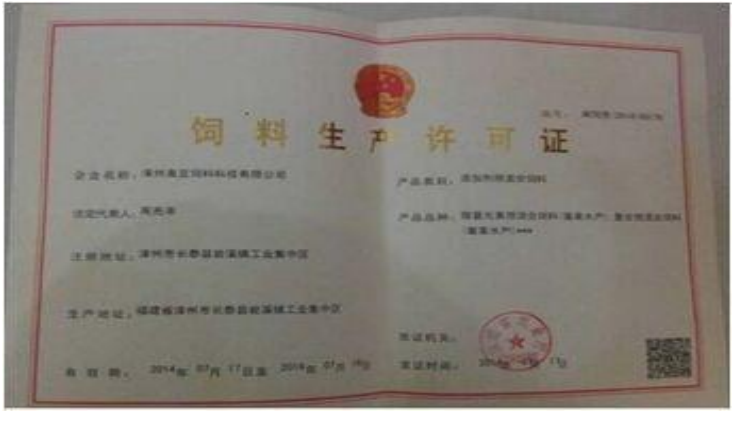
➢**Extracts of JUNCAO spent Ganoderma lucidum substrate can be used as dairy feed additives**

Added extracts (10.86% crude polysaccharide, triterpene substances) to the concentrate ,50 g/d / head, after 30 d milk yield increased by 13.79%.

➢**菌草灵芝菌糟提取物做为饲料添加剂**

在精料中添加50 g/d^{-1}/头菌草灵芝菌糟提取物（粗多糖10.86%、三萜类物质0.84%），添加30d后产奶量增加13.79%。

Extracts of JUNCAO spent *Ganoderma lucidum* substrate



Feed production license

JUNCAO can be used directly as feed for animals, such as cattle, pig, geese, sheep, deer, fish, etc. 菌草作饲料

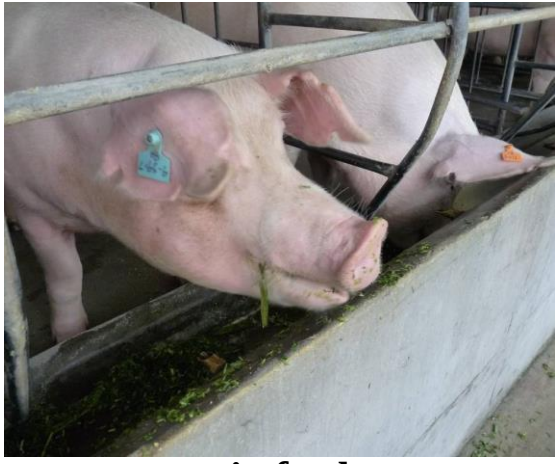
Feed packaging

cattle feed

geese feed

Silage

sheep feed



pig feed

1.3 Advantages 优越性

Three major advantages of JUNCAO industry

First, the efficient use of solar energy, land and water three agricultural resources;

Second, comprehensive cycle utilization of the plants, fungus and animals;

Third, Tightly link of the economic, ecological and social benefits.

JUNCAO industry is conducive to ecological security, food safety and energy security with the advantages of high yield, high quality, high efficiency, safety, ecology, sustainable development.

菌草产业三大优点

一、对太阳能、土地和水三大农业资源的高效利用；

二、把植物、菌物与动物三物循环综合利用；

三、将经济、生态和社会三大效益紧密结合。

有利生态安全、有利食品安全、有利能源安全，是高产、优质、高效、安全、生态、可持续发展的新兴产业。

1.3.1 High productivity of land
土地生产率高

- **High solar energy conversion rate, fresh grass yield up to 450 t / ha year;**

- **Productivity is 5.5 to 21.6 times of broad-leaf trees.**

- **菌草太阳能转换率高，鲜草产量可高达450 吨/公顷·年；**
- **人工栽培的菌草单位土地生产率是阔叶树的5.5～21.6倍。**

1.3.2 Short cycle, low cost
周期短、成本低

- Fast growth, 3 to 6 months can be harvested and used;
- Shorter cycle for mushroom production: 1 mushroom shed can plant 2 to 3 seasons Xianggu per year;
- Cost lower 10～20%。

- 菌草生长快，种植3～6个月就可采收、利用；
- 周期短，如：一个菇棚年可种植2～3季香菇；
- 成本低10～20%。

1.3.3 High biotransformation efficiency
生物转化率高

1公顷 → 300～400吨鲜草 → 100～130吨鲜菇

ha → tons fresh grass → tons fresh mushroom

中国只要用1%水土流失地 → 355万公顷 → 3.5～4.6亿吨鲜菇

1% Soil erosion areas in China → 3.55million ha → 350～460 million

1.3.4 菌草产品品质高

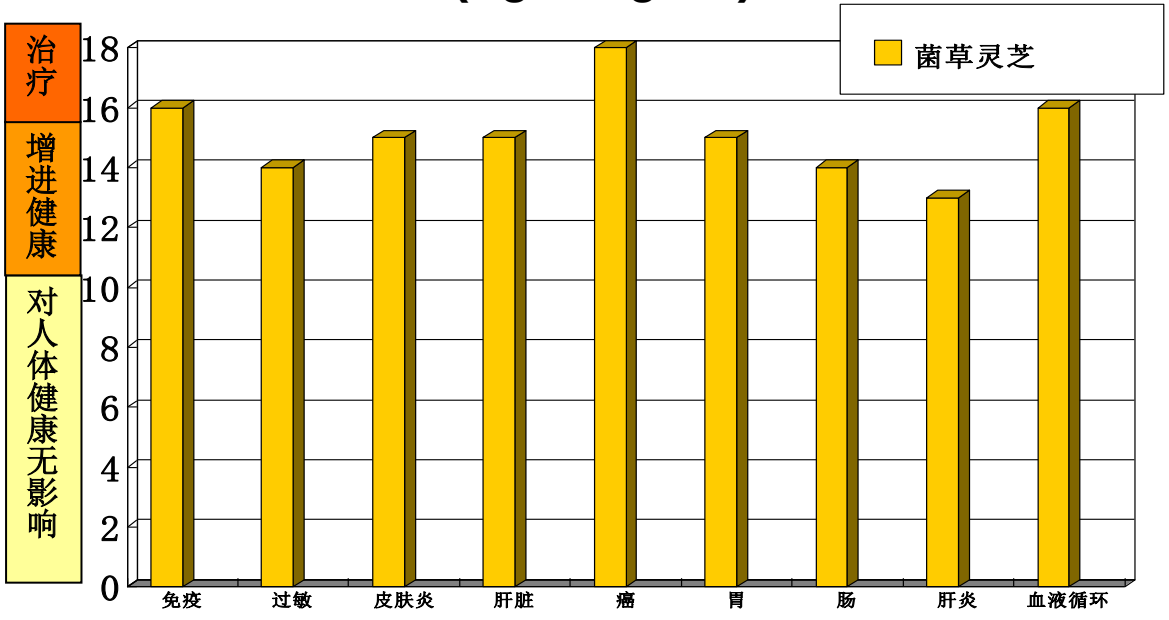
1.3.4.1菌草营养成分高

Ingredients of dry and fresh *Pennisetum* sp. and *Miscanthus floridulus*

	水分% water %	粗蛋白% protein%	粗脂肪% fat%	粗多糖% polysaccharide%	粗纤维% fiber%	灰分% ash%
干巨菌草 Dry P.sp	11.96	7.17	1.17	4.28	45.14	10.25
鲜巨菌草 Fresh P.sp	80.77	11.26	2.38	5.17	32.29	9.40
干五节芒 Dry	12.11	4.28	1.58	2.81	43.85	9.70
鲜五节芒 Fresh	75.30	6.88	1.91	3.61	47.13	9.11

1. 3. 4. 2 菌草药用菌药用价值高

High content of active ingredients of JUNCAO medicinal mushrooms (Eg. Lingzhi)



0-10: no harmful to health; 10-15: good for health;

over 15: can be used as medicine (Japan)

1.3.4.3 菌草食用菌食用价值高

A comparison of crude protein content of edible fungi cultivated with Juncao and traditional raw materials

varieties	raw materials		Juncao /other
	Juncao formula	other formula	
Tremella fuciformis	15. 74 （*Neyraudia reynaudiana* ）	13. 74 （**Cotton seed hulls**）	1. 14
Dictyophora indusiata	22. 79 （*Dicranopteris dichotoma*，*Neyraudia reynaudiana* ）	18. 53 （**Bamboo shavings** ）	1. 23
Lentinula edodes	32. 836（*Dicranopteris dichotoma*，*Miscanthus floidulus*）	28. 787（**Wood chips** ）	1. 14
Auricularia polytricha	8. 212 （*Dicranopteris dichotoma*，*Miscanthus floidulus*）	7. 997 （**Wood chips** ）	1. 02
Auricularia auricula	17. 832（*Dicranopteris dichotoma*，*Miscanthus floidulus*）	9. 861 （**Wood chips** ）	1. 81

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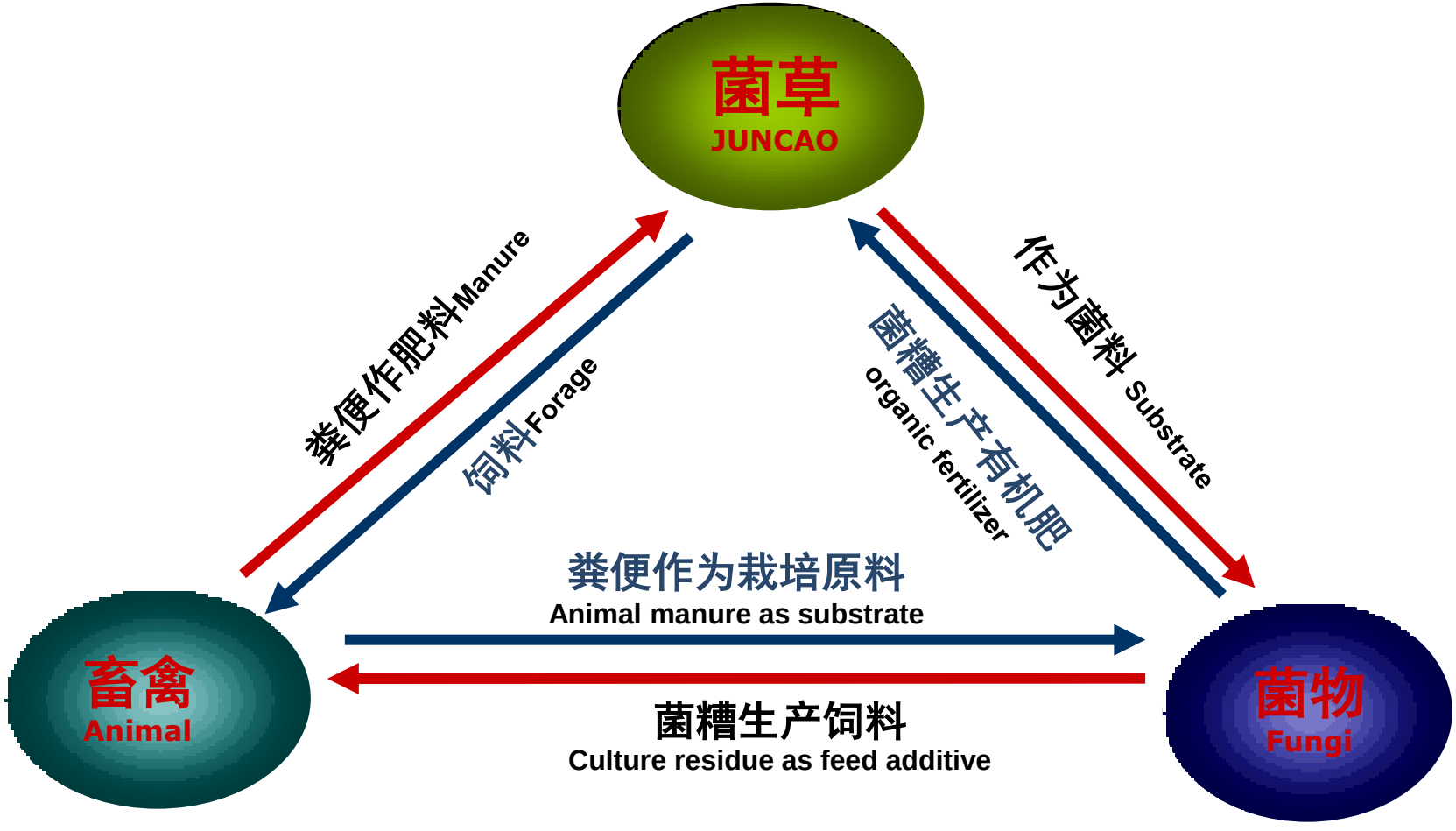
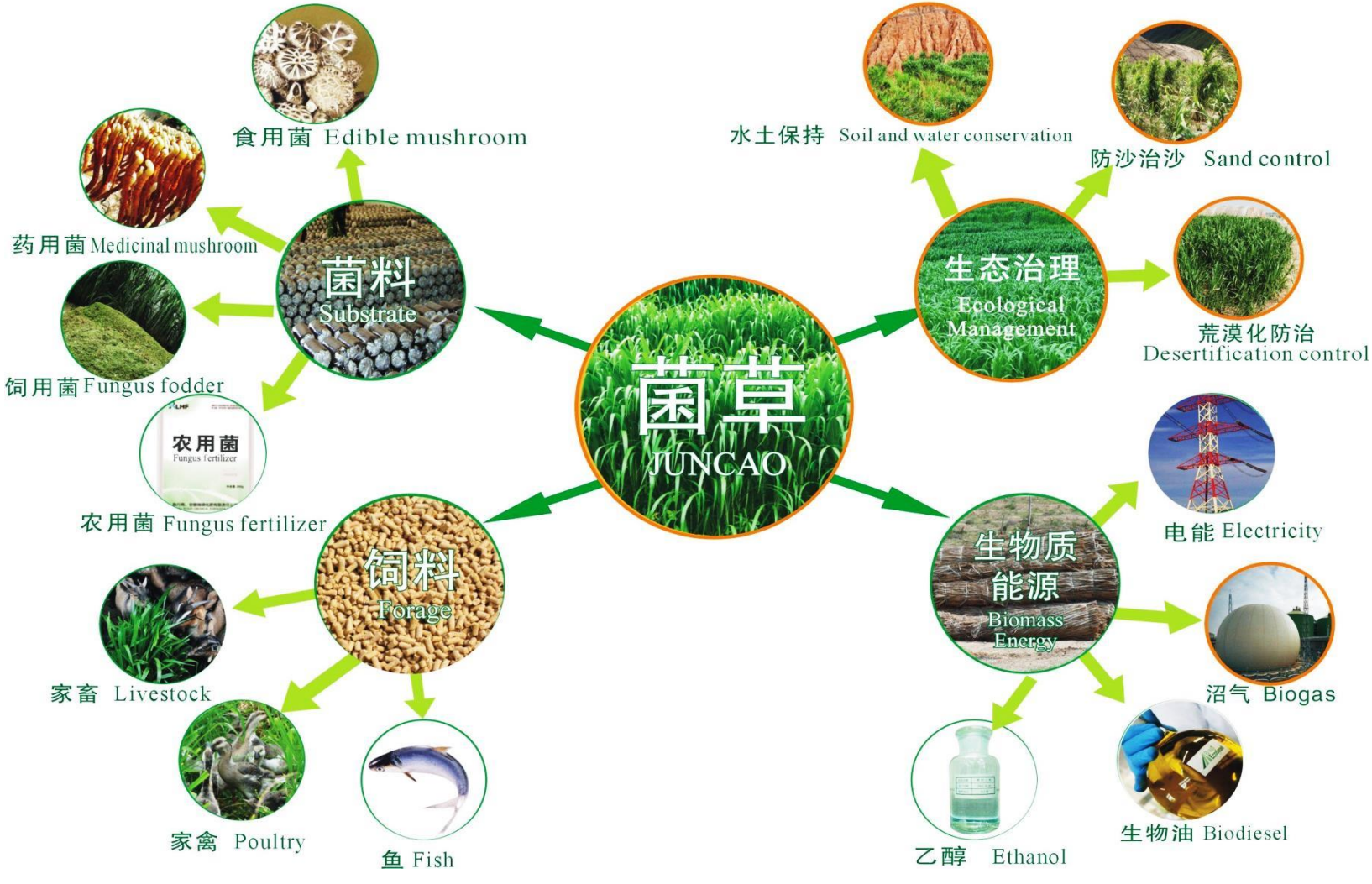
1.3.5 Cyclic production, efficient utilization of resources
循环利用




菌草
JUNCAO
菌料
Substrate
食用菌 Edible mushroom
药用菌 Medicinal mushroom
饲用菌 Fungus fodder
农用菌
Fungus fertilizer
农用菌 Fungus fertilizer
饲料
Forage
家畜 Livestock
家禽 Poultry
鱼 Fish
生态治理
Ecological Management
水土保持 Soil and water conservation
防沙治沙 Sand control
荒漠化防治
Desertification control
生物质能源
Biomass Energy
电能 Electricity
沼气 Biogas
生物油 Biodiesel
乙醇 Ethanol

1. 3. 6 Effective measure for soil and water conservation
水土保持效果好

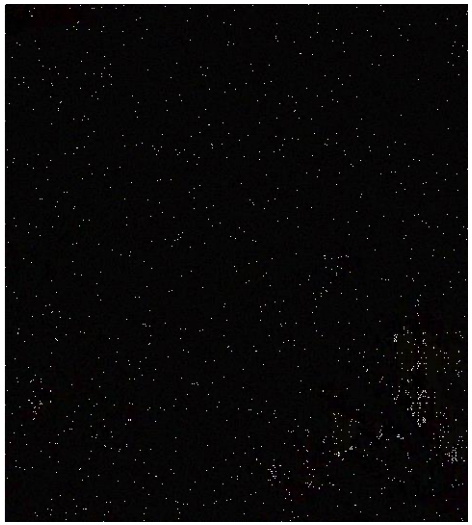
In the Soil erosion areas of Southern of China, 1yr after planting grass

- **surface runoff can be reduced by 30%,**
- **soil erosion can be reduced by 78%;**
- **90 tons/ha per year CO_2 absorbed,**
- **grass can be harvested continuously for more than 30 years.**

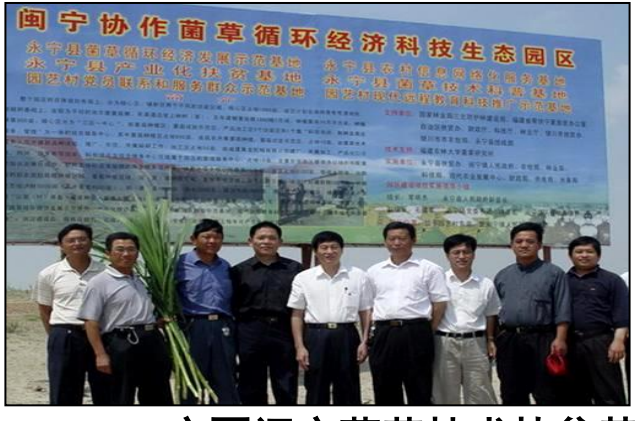
中国南方当年水土流失地地表径流可减少30%、土壤侵蚀量减少78%；年可吸收二氧化碳90吨/公顷，可连续收割30年以上。

2. 菌草产业发展应用

2.Application & Development



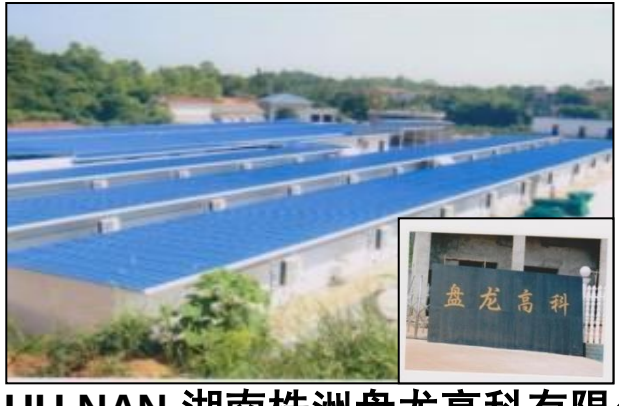
Research branches and demonstration bases



NING XIA 宁夏闽宁菌草技术扶贫基地

SI CHUAN 四川省菌草开发研究分中心

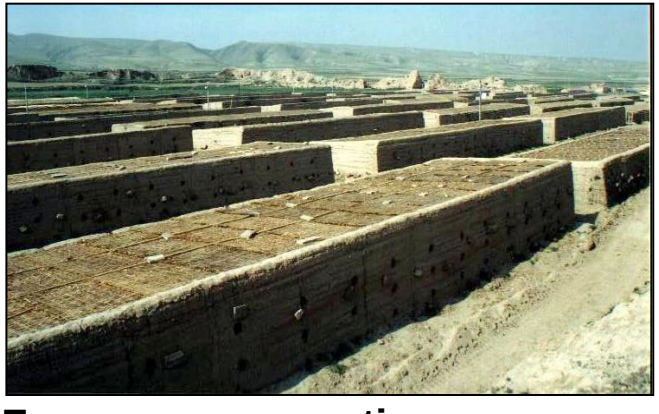
XIN JIANG 农一师阿克苏菌草示范基地



HU NAN 湖南株洲盘龙高科有限公司

Production models

Small farmer　菌草鹿角灵芝



Farmers co-operative
干旱荒漠地区菌草栽培巴西菇菇棚

Factory production 菌草温室栽培玉菇

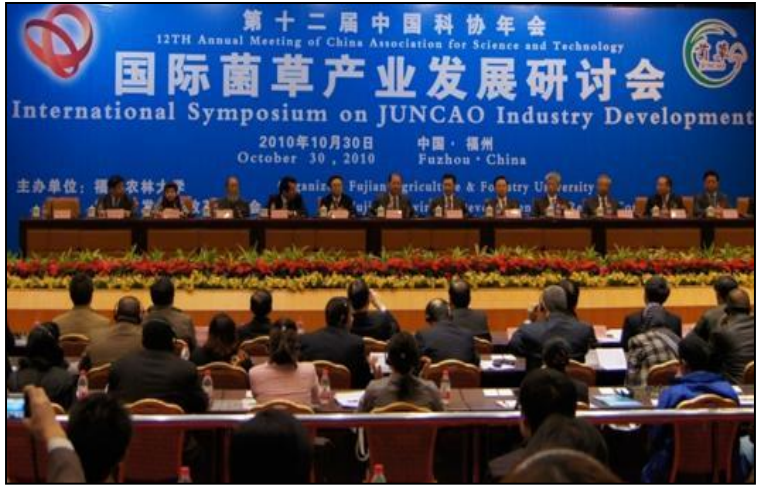
Poverty alleviation by developing JUNCAO industry

Ningxia: 17500 households, income increased 28 million USD, provide job opportunities 22800

Xinjiang: JUNCAO industry in 8 cities, with total output value of 50 million USD

Application of JUNCAO technology in developing countries

- extended to 85 countries,
- translated into 15 languages;
- 53 training course, ~1670participants；
- 10 International symposium/forum, delegates from 95 countries；



Oversea demonstration bases (6)

South Africa 南非菌草技术示范基地

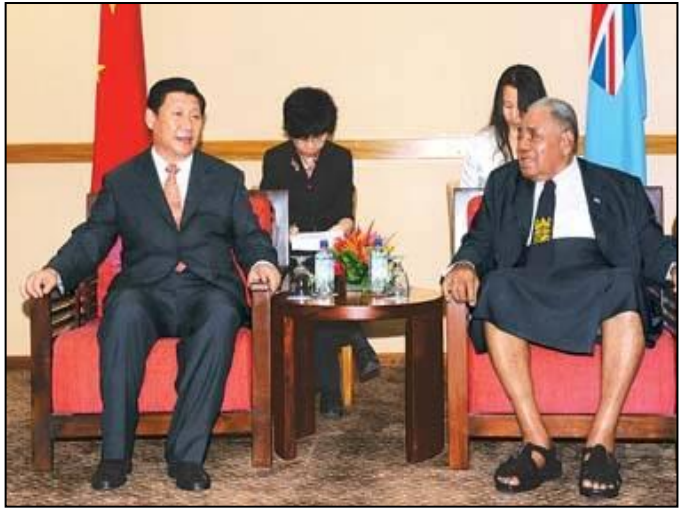
Rwanda 卢旺达菌草技术示范基地

PNG巴新菌草技术示范基地

Lesotho中莱菌草技术示范基地

3 CENTERs

- Rwanda Agricutlural Technology Demonstration Center
- Fiji Juncao Technology Demonstration Center
- South Africa Juncao Technology Demonstration Center



Cooperation

Research	**MOST or Fujian provincial international cooperation research projects,** **Post-Doc research program,** **Research fellow…**
Education	**MOE offer scholarship for Master and PHD program** **Short-term (2-mth) technical training in Fuzhou**
Project	**Inter-government, international institutions, NGOs, or directly with local governments or companies…for poverty alleviation and industry development**

South Africa

KWADINDI JUNCAO Flagship Site

JUNCAO mushroom structure

- 1 square meter=30kg per cycle
- Each member 10 square meter=300kgX4 cycles=1200kg/yr
- Work in group/co-op but with individual responsibility

菇棚

1平米-30kg;

每人**10**平米菌畦,

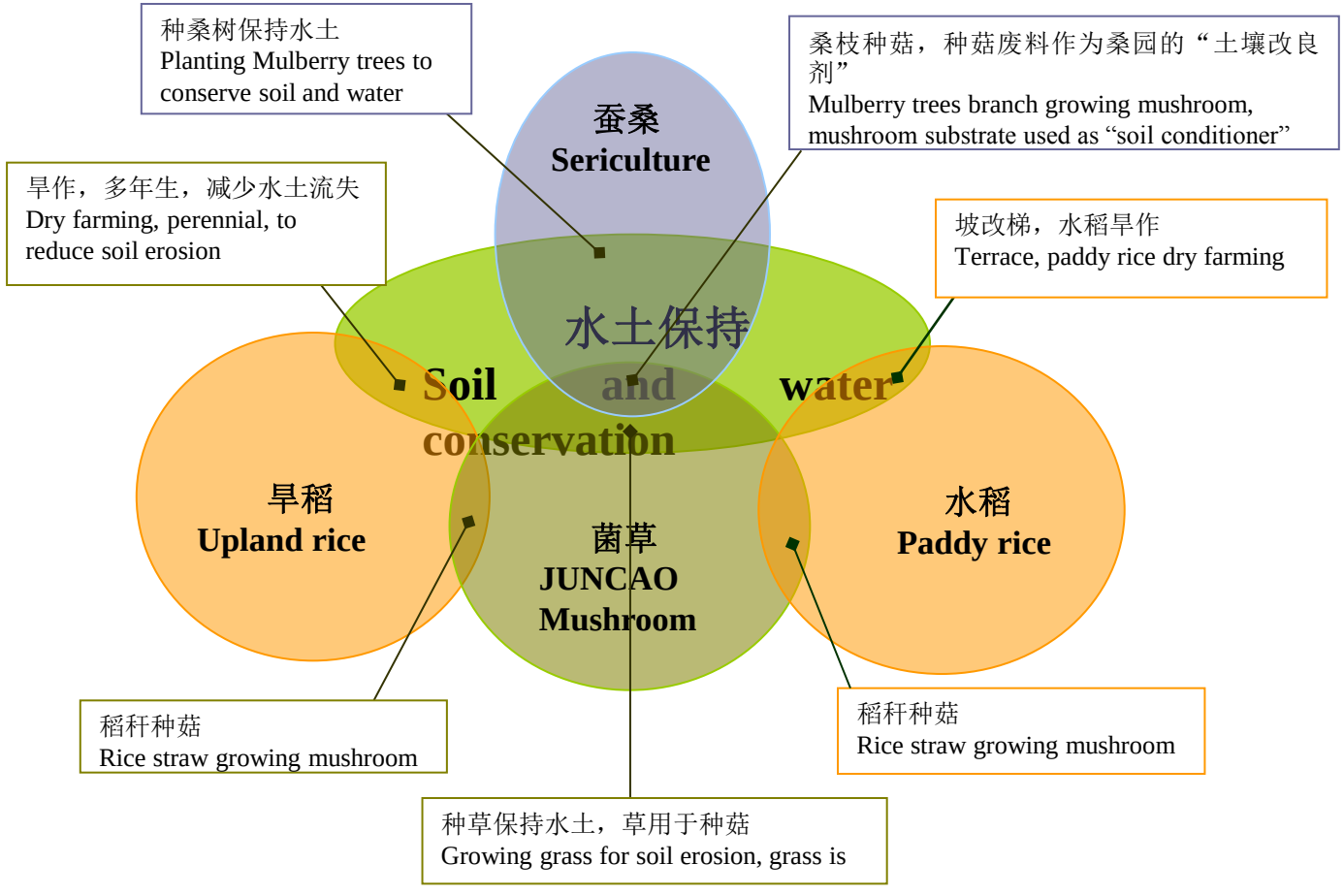
集体合作,但各自责任明确

Flagship site: bring mushroom production chain from ‘center/base’ to rural areas

Activity	Jobs	Remarks
Juncao grass planting for 5 ha and delivery to site	25	Raw material Co-op (can be integrated with livestock feeding)
Juncao grass grinding and drying	10	
Substrate production	40	Production Co-op
Substrate distribution	4	
Mushroom fruiting management & harvesting	310	Fruiting management & harvesting Co-op
Grading, storage, packaging and processing	40	
Marketing and sales	15	Processing & marketing Co-op
Spent substrate transporting / disposal / gardening	5	
Security	3	
Site maintenance manager	2	
Total	454	

JUNCAO Technology in Rwanda

Rwanda Agriculture Technology Demonstration Center – investment about 6 million USD, total 22 ha


种桑树保持水土
Planting Mulberry trees to conserve soil and water
桑枝种菇，种菇废料作为桑园的“土壤改良剂”
Mulberry trees branch growing mushroom, mushroom substrate used as “soil conditioner”
旱作，多年生，减少水土流失
Dry farming, perennial, to reduce soil erosion
坡改梯，水稻旱作
Terrace, paddy rice dry farming
蚕桑
Sericulture
水土保持
Soil and water conservation
旱稻
Upland rice
菌草
JUNCAO
Mushroom
水稻
Paddy rice
稻秆种菇
Rice straw growing mushroom
稻秆种菇
Rice straw growing mushroom
种草保持水土，草用于种菇
Growing grass for soil erosion, grass is

Develop JUNCAO industry Benefit the mankind

发展菌草业 造福全人类

Thank You !

谢谢！