The Introduction of Juncao Technology

Dr. Dongmei Lin
China National Engineering Research Center of Juncao Technology
Fujian Agriculture & Forestry University
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Email: 982245079@qq.com
CC: YFJuncao@outlook.com

1. Juncao Technology & Juncao Industry

What is Juncao Technology?

Jun

真菌、菌菇
mushrooms or fungi

cao

草本植物
grass or herbaceous plant

Research on Juncao technology ‘using grass to replace wood’ to grow edible and medicinal mushrooms started in 1983 by Prof. Lin Zhanxi, and firstly succeeded in 1986.

A new **research field** that crossing fungi & herbaceous plant.

A new **category** of grasses.

A new **resource.**

Juncao technical system > **60** patents

Juncao: Herbaceous plants that can be used as the culture substrate for cultivation of edible and medicinal fungi.

** 49 species of Juncao (herbaceous plant) have been screened and bred to cultivate 56 species of edible and medicinal mushrooms.*

Juncao Technology: A comprehensive technology that utilizes Juncao to cultivate edible mushroom, medicinal mushroom, produce feed and fertilizer, etc.

Juncao Industry: A sustainable industry formed by application of Juncao technology and other interrelated techniques.

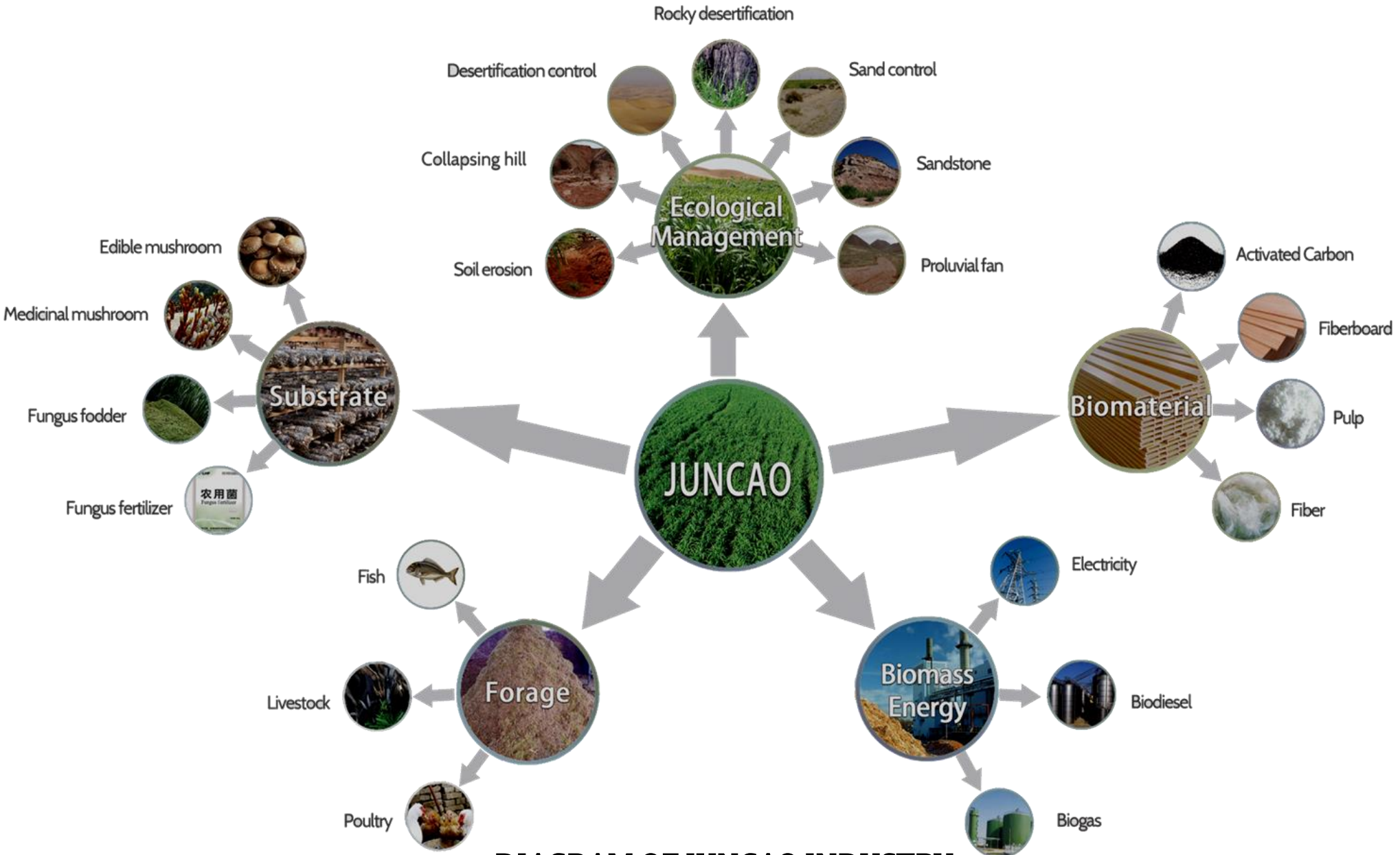
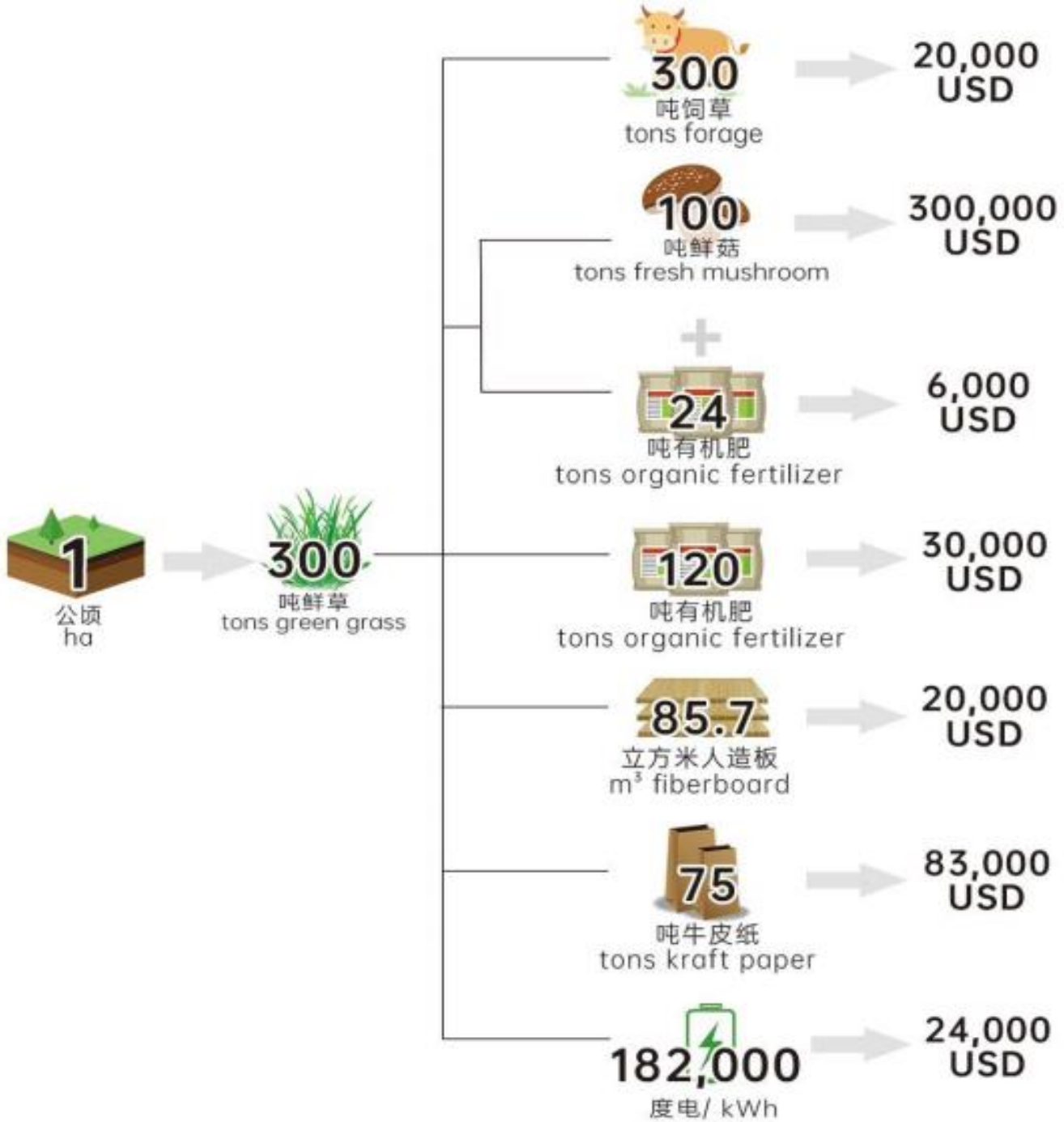


DIAGRAM OF JUNCAO INDUSTRY

Economic value

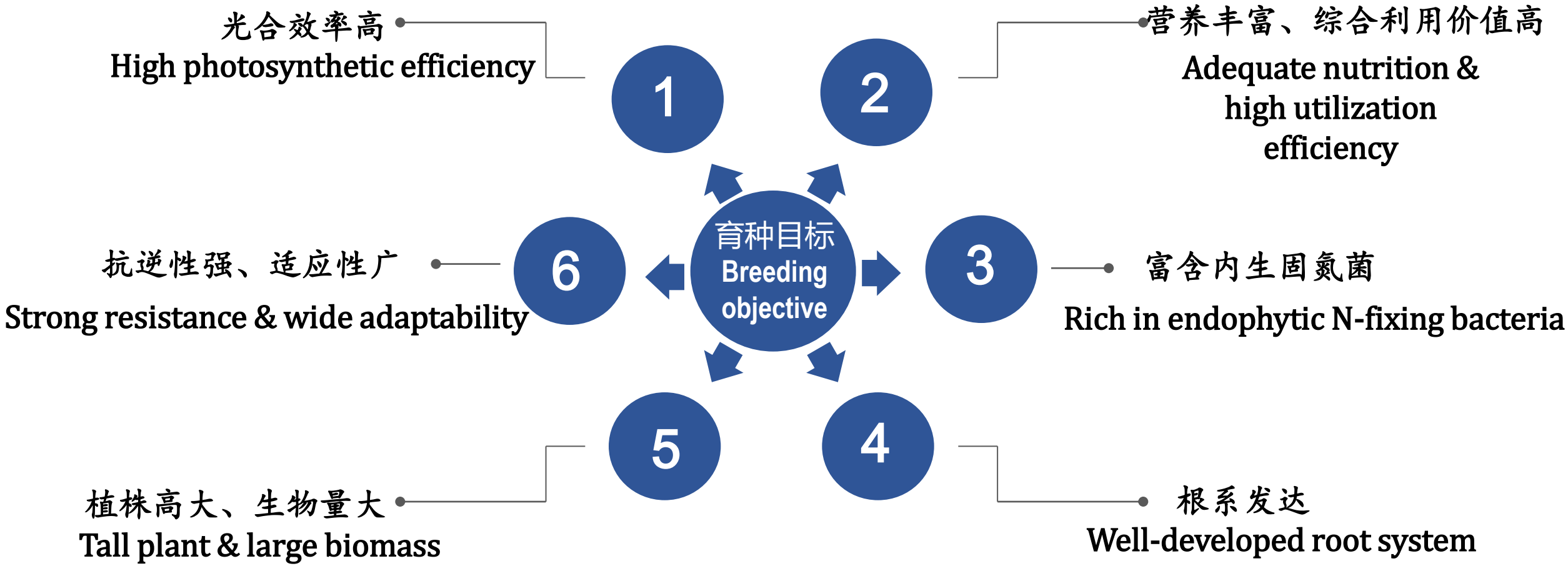


1-1 Screening and breeding of Juncao grass

In the 1980s: wild grasses, agricultural byproducts

Since the 1990s: Juncao grass species adapted to different climate conditions and planted at a large scale

Criteria for screening and breeding of Juncao grass



Biosafety

A risk assessment index system of *Giant Juncao* grass was established with the aim to evaluate the risk rank of Giant Juncao grass in Fujian Province.

Dispersal controllable

- no seeds, asexual reproduction
- no rhizome
- cannot regenerate when T< -4 ℃
- easy to control, easy to eradicate

No risk of invasion

The Biosafety Assessment of Introduced *Pennisetum* sp. in Fujian Province, China

PENG Lu[1,2,3], YANG Yi-Fan[2,3,4], HOU You-Ming[1,2,3*], LU Guo-Dong[1,2]

(1. *Department of Plant Protection, Fujian Agriculture and Forestry University, Fuzhou, Fujian* 350002, *China*; 2. *Key Laboratory of Integrated Pest Management on Crops in Fujian-Taiwan, Ministry of Agriculture, Fuzhou, Fujian* 350002, *China*; 3. *Fujian Provincial Key Laboratory of Insect Ecology, Fuzhou, Fujian* 350002, *China*; 4. *College of Life Science, Fujian Agriculture and Forestry University, Fuzhou, Fujian* 350002, *China*)

Abstract: Based on analyzing the introduced ways, biological characteristics, and potential hazards of *Pennisetum* sp, as well as the ecological environment and management status, an index system for risk assessment of *Pennisetum* sp. was established, consisting of 3 different layers, ie. objective, criteria, and index layers, which include 20 index parameters, by following the principle of essentiality, systematicness, practicality and portability, and used to evaluate the risk rank of *Pennisetum* sp. in Fujian Province. The results showed that there was no risk to plant *Pennisetum* sp. in Fujian Province, which can be introduced or need not to take any preventive measures. Our work provides a theoretical basis for the safety of introduction, and large-scale cultivation and production of *Pennisetum* sp. in Fujian Province, beside that it will be of great importance in improving the economic benefit and protecting the biodiversity in our country.

Key words: introduction; *Pennisetum* sp.; biosafety; risk assessment; biological invasion

1-2 Mushroom cultivation

56 kinds of edible and medicinal mushrooms are cultivated. Eg. Shiitake msuhroom (*Lentinula edodes*) cultivation, if Juncao grass replaces 50% wood, 10 million m^3 wood will be saved per year.

Growing *Lentinula edodes* with Juncao Grass

Growing *Ganoderma lucidum* with Juncao Grass

- **High yield, good quality, and sustainable development.**

  1 ha land with yield of **300** tons of fresh grass can produce **120** tons of mushrooms.

- **Flexible production methods**

  Suitable for large-scale production and small farmers.

- **High value-added products**

  Deep-processing mushroom products such as tonic food products, health care products and medicines.





Higher crude protein level of Juncao mushrooms produced with grass substrate

A comparison of crude protein content of mushrooms cultivated with Juncao & other raw materials

Varieties	Raw materials		Protein ratio
	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








Manual Production

Milling

Packaging

Sterilization

Inoculation

Incubation/spawn run

Mushroom Fruiting

Factory Production

Mushroom Packs Workshop

Sterilization Workshop

Liquid Spawn Culture Workshop

Intelligent Inoculation Workshop

Mycelium Culture Workshop

Intelligent Harvest Workshop

1-3 Forage

The crude protein content of Giant Juncao is 11.33-17.74%. The sensory evaluation of silage Giant Juncao is **excellent**, and the ratio of **ammonia nitrogen to total nitrogen** is 2.97, which meets the standard of high-quality forage.

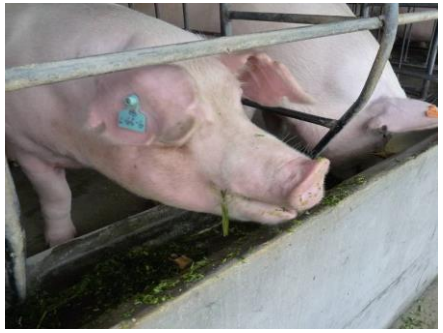
Silaged Giant Juncao grass **pH 3.94。**
The weight gain of cattle fed with silage Giant Juncao grass is similar to that of silage corn.
The effective degradation rate of DM and CP in the rumen of beef cattle and wether are 46.80%, 49.29%, 59.52% and 57.89%, respectively, which meets the middle and upper forage standard.

Test of Comparative Effect of 3 Different Silage Feeds on Fattening Cattle provided by the Farmers Cooperative of Gansu Province

Group	(kg/head) Initial weight	(kg/head) Final weight	(kg/head) Weight gain	(kg/head) Daily gain
A Silage Giant Juncao grass	617.20±40.55	672.20±42.46	**55.00±8.92**	**1.10±0.18**
B Silage whole plant corn	622.00±25.80	680.00±26.09	58.00±4.85	1.16±0.97
C Silage sweet sorghum	618.00±23.45	671.20±23.81	53.20±2.05	1.06±0.41

*** 16 kg silage grass** per head per day + **8 kg concentrated feed** per head per day.

Aerial photography Juncao planting base



Mechanized harvesting

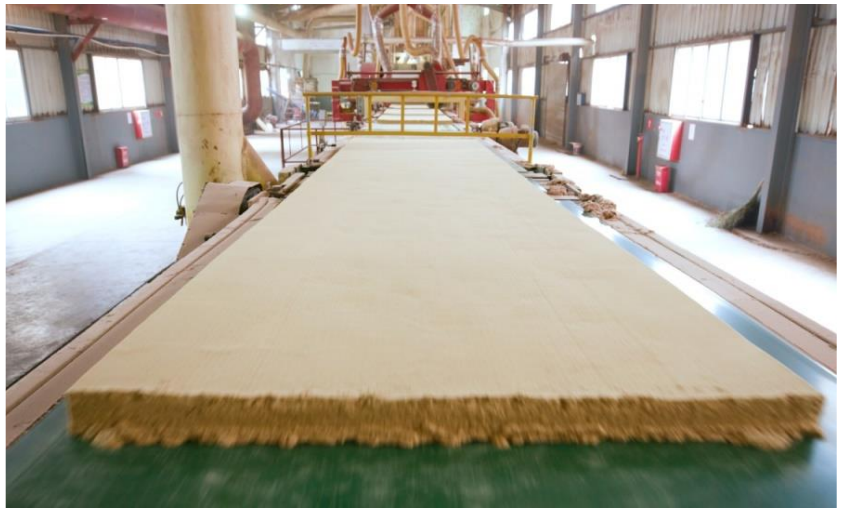
Silo of Giant Juncao Grass

Silage Pack of Giant Juncao Grass

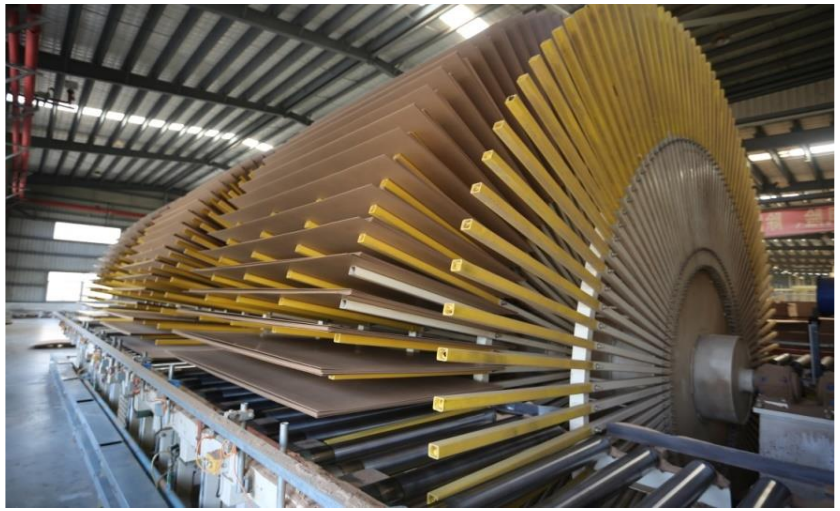
1-4 Grass fiberboard

Feeding

Smashing



Board making



Drying

1-4 Grass fiberboard

- Increase carbon storage with “Grass replacing wood”

Some Juncao varieties can replace wood to make high-performance artificial boards.

Fast-growing *eucalyptus* takes 5-6 years for harvest, and the general high-quality wood would need even 12 years, while Juncao can be harvested and used in the year planted.

Juncao substituting **wood,** fixing carbon **6.7~67.5** t/ha annually, **will reduce forest logging and replaces valuable forest carbon sink** resources.

1-5 Biomass energy

The combustion value of dry Juncao grass (Giant Juncao grass) is **3580 kcal/kg**, equivalent to **0.716 kg** raw coal； and it can genereate **0.548 m^3** biogas.

52.5~60 tons raw coal

1ha Giant Juncao grass

74,000 m^3 biogas

2. Juncao Grass Green Barrier

Climate Change

Disaster prevention

Soil erosion control, flood regulation,

Disaster reduction

Tolerant to drought, flood, cold, wind…

Production recovery after disaster

Island & Beach

Pingtan Island

More than 300 days of strong winds above level 6 and 200 days of strong winds above level 7 and at least 5 typhoons every year.

Juncao grass are planted at **Changjiangao** where offshore wind power farm is located, and **Xingfuyang** where the reclamation land has high salinity. *Casuarina equisetifolia* is difficult to survive at both sites.

Island & Beach

Resource utilization and environment protection

1. Juncao grass as shelter belt at wind gap

Fixes sand and blocks wind to protect the plants, farmland, roads and buildings.

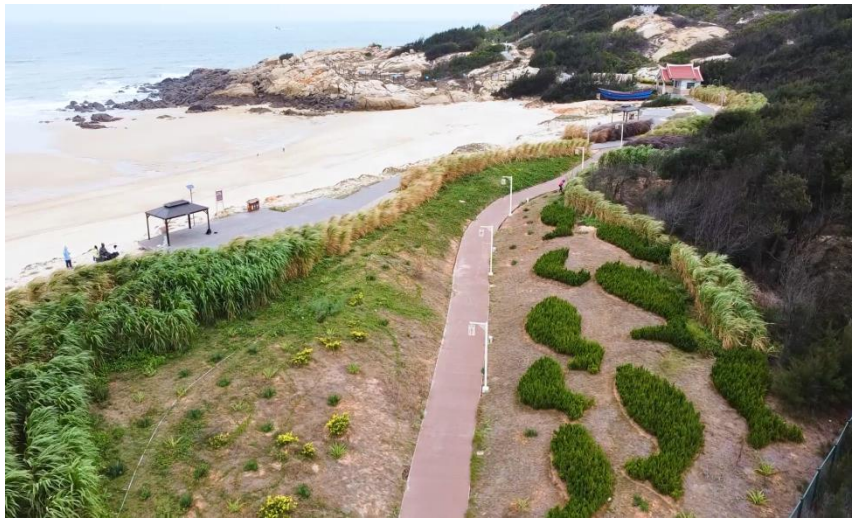
2. Juncao grass planting improves land utilization

-Saline & alkaline land

-Solid waste (construction waste) landfill

-Rocky shore

3. Juncao grass planting sites become tourism attraction



Desertification Area

In the Yellow River basin, Juncao grass are planted to reconstruct or restore vegetation and act as shelter belt or pilot plant to build a biological barrier

Ecological functions: windbreaking, sand fixation, water conservation, improvement of soil quality, biodiversity, habitat and so on
Economic functions: production of feed, mushroom and organic fertilizer
Social functions: poverty reduction and job creation.

Rocky Desertification Area

Bangadng Town, Ziyun County, Guizhou province

The 3 villages of Xintang, Xiaozaiguan and Luomai were area of deep poverty, with steep hills and shallow soil, very little income for local people from crop production.

Juncao Industry lifted more than **2000 households** out of poverty. Poverty reduction rate of Luomai village reduced from **15.7%** (2016) to **0.98%** (2020).

An ecological cyclic industry chain based on Juncao grass

Grass: about 140 ha of Giant Juncao grass planted

Livestock: fresh grass feed (selling at 400 yuan RMB/ton) to feed rabbit, pig, goat, cattle, and poultry, or be processed into silage feed (selling at 550 yuan RMB/ton).

Mushroom: produce 7 million mushroom substrates packs per year with Juncao grass, 160 mushroom green houses built

Organic fertilizer: spent mushroom substrates are turned into organic fertilizer and applied back into the grassland.

Soil Erosion Area

Rwanda: the soil loss rate and water loss rate were reduced by **97.05-98.9%** and **80.0-91.9%** respectively.

Cultivation models	Wet weight of soil （kg)	Dry weight of soil （kg)	Reduce soil loss rate compared to traditional crops （%)
Model of local traditional crop cultivation	656.7	484.18	——
Model of intercropping crops with Giant Juncao grass on contour line	27.18	20.25	95.80%
Model of planting JUNCAO grass	8.6	5.93	98.90%

* Rainfall 51ml from 17:00-19:30 on 30th Oct. 2012

Maize cultivation

Intercropping Juncao grass with maize

Juncao grass planting

River Bank & Flood Land

- Conserve river water source
- Intercept non-point source (NPS) pollutants and purify water
- Wave dissipation
- Shore line protection
- Provides rich resources for animals, insects, birds and other organisms, and is a paradise for organisms
- Form a landscape
- Regulating local microclimate

Abandoned Mine Land

Heavy metal contamination

Absorb heavy metals in soil, e.g. Cu 3781 g/ha, Hg 297g/ha, Cd 28.8 g/ha

Saline & Alkaline Land

Eg. Giant Juncao grass can survive and grow normally under low and moderate salinity （pH 4-8.7).

Soil Improvement

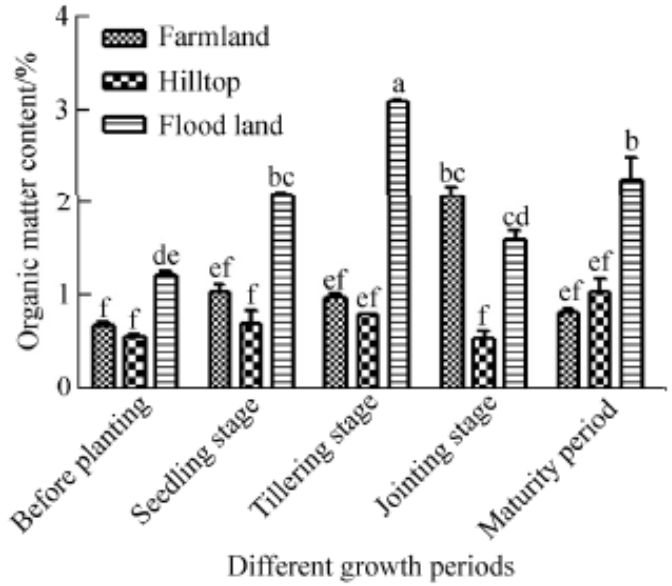


图 2. 不同生长时期巨菌草土壤有机质含量的变化

Figure 2. The change of organic matter in the soil at different growth stages of *Pennisetum* sp. The significant difference (P<0.05) between the organic matter contents of different soils is indicated by the letters a, b, c, d, e, or f.

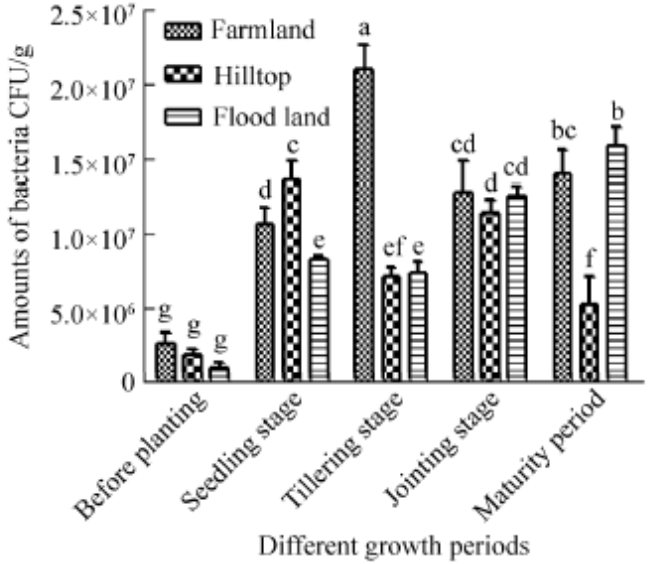


图 4. 不同生长时期巨菌草土壤细菌量的变化

Figure 4. The change of the amounts of bacteria in the soil at different growth stages of *Pennisetum* sp.. The significant difference (P<0.05) between the number of culturable bacteria of different soils is indicated by the letters a, b, c, d, e, f or g.

Juncao grass planting significantly promotes the diversity and richness of soil bacterial flora and effectively improve soil organic matter content.

Biodiversity

in Arid Area & Humid Area

Mingqing County, Fujian province

Insect species richness increased by more than **260%**, significantly affect the community of plant and insect diversity.

It increases **the soil microbial community functional diversity** and improve **soil fertility**.

1 month after planting

3 months after planting

Before: desert sandune

Insects: 16 species

Plants: 7 species

+ 143.75%

+ 185.71%

After: desert with Juncao grass planted

Insects: 39 species

Plants: 20 species

Animals attracted to Juncao technology desertification control experiment base, Inner Mongolia

3. Juncao Aid Projects and Extension

To extend Juncao technology

1. Set up demonstration bases,
2. Education and academic research programs,
3. Trainings and extensions,
4. Cooperation with private sectors,
5. Conferences and visits, etc..

- Fujian Agriculture and Forestry University has enrolled **24** young students from **11** countries to study Juncao Science with disciplines of Biology, Microbiology, Ecology, Agricultural Resources and Environment, and offered Juncao Science courses for foreign students, including Juncao Science research, Juncao technology extension and sustainable development.
- By now, **18** languages are in use for extension of Juncao technology, and totaling **270** training programs have been held at home and abroad with **10,509** participants trained.
- Set up Juncao technology demonstration bases in **13** countries.


2019年中非菌

18 International Symposiums on the Development of Juncao Industry

China's Experience in Poverty Reduction with Juncao Technology-
Fujian-Ningxia Cooperation

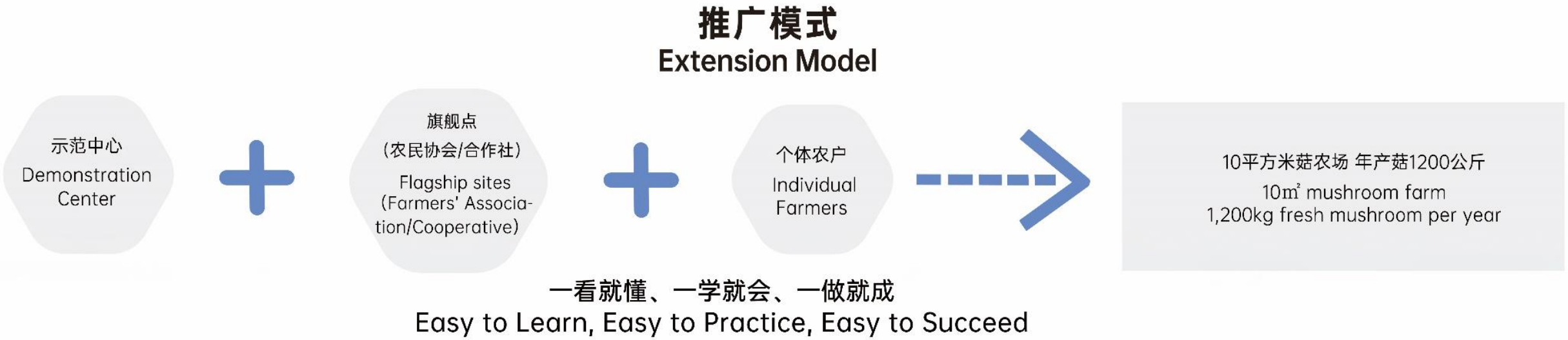
In the arid desert of **Ningxia**, Juncao technology helped more than **17,500** households up and out of poverty, and as a result the farmers' average annual income grew from **$80** in 1998 to **$1,024** in 2007, in only 10 years.

TV Series “Minning Town” tells the story of immigrants moved to Minning Town (named with short name of Fujian and Ningxia), getting rid of poverty with Juncao Technology by production of mushrooms.

Today’s Juncao Technology Innovation Industrial Park in Suburban of Shizhuishan, Ningxia

Four Strategies for Juncao technology extension for poverty reduction/foreign aid

- People-centered philosophy
- Simplification of technology
- Poverty reduction by developing industries
- Adaptation of technique, extension model and talents nurturing

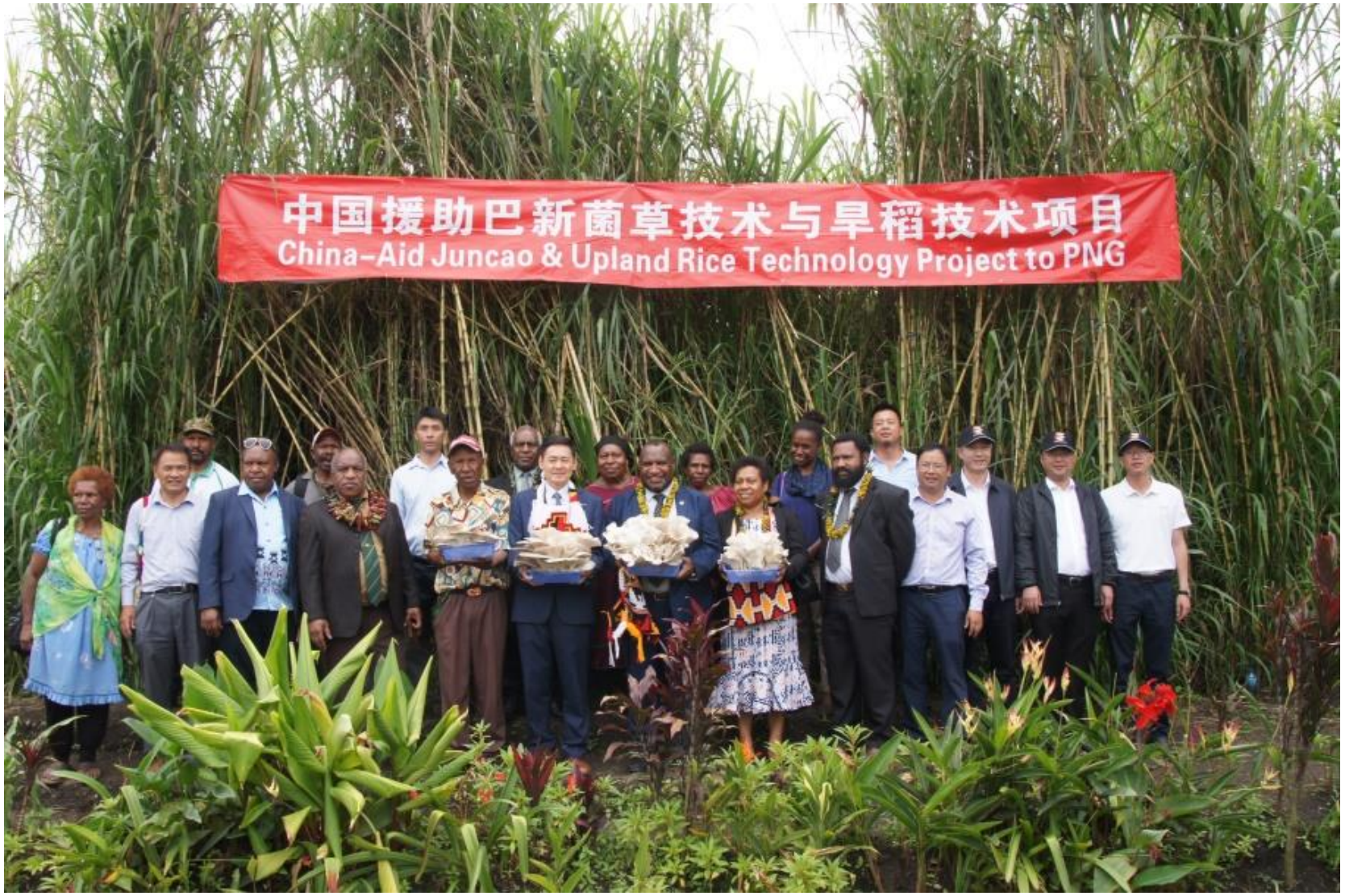


Eight Functions of Juncao Technology Demostration Base：

- Adaptability research
- Breeding of Juncao grass and mushrooms
- Demonstration & production
- Product processing
- Technical training
- Extension & consulting service
- Science popularization and education
- Market promotion

4. Success Stories of China Assistance Juncao Projects

Juncao Project in Papua New Guinea



Juncao technology has been extended to **16** regions in **8** provinces, and offered trainings to more than **8,600** households, and benefited over **30,000** people. Juncao technology has been regarded as a **pillar industry** for economic development and achieving sustainable development goals in EHP.

16 | The National
Thursday, September 12, 2019

Farming

DAL and stakeholders promote Chinese Juncao technology

A CHINESE agriculture technology that has gained international recognition is to be introduced to other parts of the country.

The Juncao technology and upland rice planting methodology has been developed in the Eastern Highlands for over 20 years but will now be extended to other provinces.

A three-day workshop was held recently hosted by the Department of Agriculture and Livestock, Eastern Highlands Provincial Administration and Fujian Agriculture Forest University (FAFU) to discuss and disseminate the latest agricultural innovation to farmers, organisations, cooperative groups and government officials.

Juncao merges two words in Chinese language, *'Jun'* means Fungi and *'Cao'* means grass, it is a technology and an innovation that accelerates the growth of the fungi industry using a vigorously growing grass specie that grows to 8m and is patented for use worldwide to address erosion, desertification, biomass energy, soil improvement fertiliser, livestock feed for cattle, goat, pig and poultry, fencing stake and most importantly, a substrate to grow mushroom for both consumption and medical use.

DAL Deputy Secretary, Stephen Mesa, in his opening remarks stated that; "the two technological interventions the Juncao technology and Upland Rice Project are bonded by the Bilateral Agreements between the two governments of China and Papua New Guinea. EHP and the rest of the Papua New Guinea must rise and run with these technologies, given the national governments challenge to increase production, revenue and wealth creation for the people of Papua New Guinea."

Officials and Participants at Juncao and Upland Rice Workshop Goroka Juncao Base. Background is the Juncao Grass.

FAFU teams pioneer 76-year-old inventor; Professor Lin Zhanxi, informed the participants that each person was an ambassador of the Juncao Technology, he developed some 30 years through painstaking research worldwide and introduced into Lufa District of EHP, having set foot on PNG soil in 1997. Thus, the subsequent signing in 2000 for a sister city relationship between Xi Jinping (current President of China) then Governor of Fujian Province, China and Hon. Peti Lafanama then Governor of Eastern Highlands, PNG set the collaboration pathway, enabling FAFU scientists to set historical milestones such as growing upland rice using natural conditions where its planted in dry conditions and the growth and production depends on rainfall for moisture where there is no paddy rice or irrigation system. Upland Rice can be grown on flat and hilly slopes showing that rice can also be grown in the Highlands of PNG.

The trials of Golden Mountain 1 rice variety in EHP set a world record of 13 harvests from one planting, harvesting 13.32 tonnes in 1.0 hectare. In addition, the Juncao technology has resulted in the cultivation of edible mushroom, improvement of pasture options, and set a platform to promote a local mushroom industry for future commercial expansion.

DAL acting Secretary, Daniel Kombuk, said PNG's gratitude to the Chinese Government for making available the Aid project to support the development activities of the Juncao Technology and Upland rice programme, with special emphasis on Prof. Lin Zhanxi's commitment to bring this technology to PNG.

The documentary "Juncao Technology - EHP Mushroom and Dry Land Rice" was made by Eastern Highlands Provincial Government to commemorate the 20 years' history of bilateral friendly cooperation.


China-Fiji Juncao Technology Demonstration Center
援斐济菌草技术示范中心

The Juncao planting area has exceeded **500 hectares**, and provides nearly **50,000 tons** of high-quality forage every year, which effectively alleviated the shortage of green fodder in the dry season and beefed up the animal husbandry development.

License No. FM 218/18

MINISTRY OF INDUSTRY, TRADE AND TOURISM

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Fiji-China JUNCAO Technology Demonstration Centre

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Hon. Faiyaz Siddiq Koya
Minister for Industry, Trade, Tourism, Lands and Mineral Resources

mushrooms fiji

NEWS / LOCAL NEWS

Rural women learn science of growing mushrooms

ROHIT DEO | 11 February, 2020, 7:10 pm

Women from the villages of Naivucini, Saumakia, and Drauleba in Naitasiri, who attended the mushroom training with FCLC chief executive officer Jiu Daunivalu (standing far left, second). Picture: SUPPLIED

Sixty-four women from the villages of Naivucini, Saumakia and Drauleba in Naitasiri have taken to learning the science of growing mushrooms through a recent training.

According to a statement, the training was conducted by the Fiji Crop and Livestock Council (FCLC) and supported by the Ministry of iTaukei Affairs and Ministry of Agriculture.

"The mushroom training was specifically for the women and we needed an interim crop with a quick turnover to fill the gap in the period that our yaqona crops are maturing," said Ledua Vereti, the advisor to the village community council of Naivucini.

A combination of classroom and field work saw the women learning the basics of planting oyster mushroom substrates, preparation for pre-harvest and post-harvest marketing, and growing the Juncao grass which is a source of nutrition for mushrooms.

Mr Vereti said that the farming of oyster mushrooms, which would solely be an activity for the women, and the planting of yaqona by the men, were in line with the Naivucini community's short, mid and long term plans to improve their living conditions, invest in the stock market, and real estate.

The training was facilitated by the president of the Fiji Mushroom Farmers Association, Susan Pocock.

FCLC chief executive officer Jiu Daunivalu said she was pleased to see the interest emanating from rural communities for mushroom production.


China-South Africa Juncao Technology Demonstration Center
援南非农业技术示范中心

$10m^2$ mushroom trench

=**300kg** fresh mushroom * **4** seasons

=**1,200kg** fresh mushroom per year

Fresh mushroom sold at **30-40 Rand/kg**

Income: **36,000-48,000** Rand a year

Juncao Project in Lesotho

A song was written and performed by women from Mabote Mushroom Association of Lesotho, translated from Sesotho language.

“7-Day Mushroom”

Some people say it is a wild crop
Some people say it is the economic lifeline
Oh see this crop, an amazing crop
It is food, medicine and hope
I call it '7-day mushroom’
I planted on last Thursday,
taking care just like a child
Today it is Friday. I harvest, I cook the mushroom
and I even sell
Be hurry, or you will regret
Those from East say, you should not teach a
person to eat fish but teach him to go fishing.
I have attracted you now, my dear women,
working hard so that people can have better life.


中国援助
CHINA AID
FOR SHARED FUTURE
菌草菇菌袋生产旗舰点
JUNCAO MUSHROOM SUBSTRATE PRODUCTION FLAGSHIP SITE
中国援莱索托菌草技术合作项目
China-aid Juncao Technology Cooperation Project in Lesotho
LESOTHO
PLANT PROTECTION
& QUARANTINE
ORGANIZATION
AU 976


China-Rwanda Juncao Technology Demonstration Center
援卢旺达农业技术示范中心

Juncao Project in Rwanda

- Create jobs for poor people and have trained more than **20,000** people.
- More than **3,800** households are involved or benefited on Juncao mushroom production.
- Directly supporting **50** cooperatives & companies.

The water and soil conservation mode that combines local traditional agricultural production is demonstrated at the Center, such as “**contour Juncao grass planting**”, “**Juncao grass interplanting crops on the terrace**” with low investment and quick returns, which enjoys tremendous popularity among famers.

Juncao Project in Central African Republic

In 2019, Juncao technology was successfully started in Central African Republic with **5** training courses held and a simple production line built, providing farmers in Nguéréngou Village technical guidance for mushrooms cultivation. The China-aid Juncao Technology Project was implemented in May 2021, with a plan of serving **1200 households** and training **1,200 people within 3 years**.

Juncao Project in Madagascar

Agricultural technicians learn to grow Juncao in Morondava City.

Juncao Demonstration Base was established at the Rural Development and Agricultural Application Research Station in Anchibeira City.

Juncao Project in Brazil

Dr. Araidle Urben from EMBRAPA Genetic Resources & Biotech vigorously promoted the adaptive research and dissemination of Juncao technology. She has organized **53 training sessions** for more than **2,000 participants**, translated "Juncao Technology" into Portuguese and **published 4 books.**

UN Partners

Juncao assistance provides an effective and comprehensive solution that plays a positive role in the implementation of the **13** Sustainable Development Goals.

The United Nations Department of Economic and Social Affairs(**UNDESA**), the Food and Agriculture Organization(**FAO**), and the World Food Program (**WFP**) actively support the promotion and application of Juncao technology, promote South-South and triangular cooperation, and help developing countries further enhance their independent development capabilities.


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第十七届国际菌草产业
The 17th International Symposium for JUNCAO
主 办


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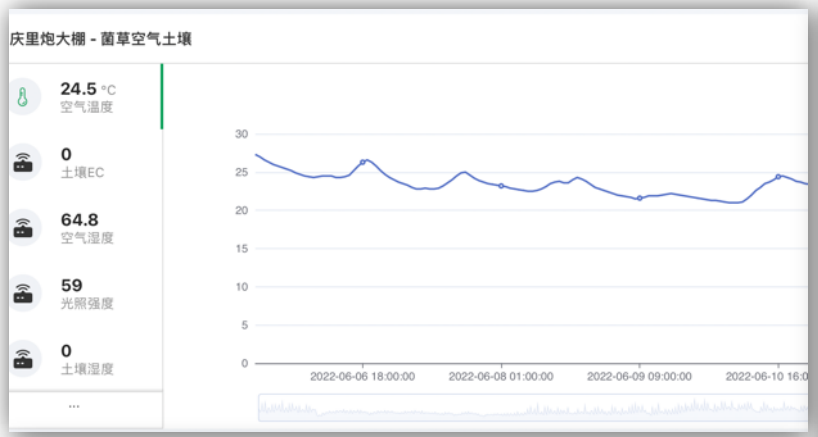
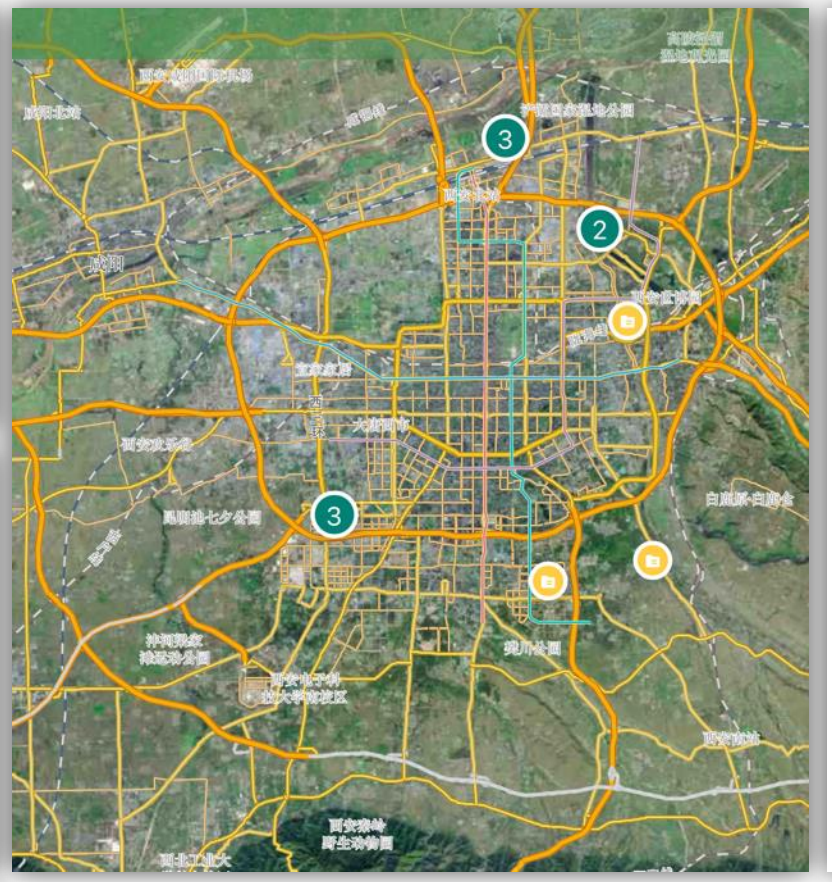
4. Smart package of Juncao Demo Base

Smart Juncao Overview

- **Smart Juncao Cloud Platform:**
  - Data Analytics
  - Record the process of plant growth
  - Guide the planting, fertilization, irrigation and harvest
- **Local Weather Station:** Temperature/Relative Humidity/Wind Speed/Sunshine Intensity/Rainfall
- **HD Camera:** Observe the plant growth and development
- **Soil Sensor:** Observe the water changes in the root system and use the data to guide precise irrigation





Samples of UI
(Multi-Language under development)

菌草 JUNCAO

发展菌草业 造福全人类

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Thank You!

Please indicate the source for the citation of the data and statistics.