The Latest Research Progress and Application of Juncao Technology and Sustainable Development

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1. Overall Introduction of Juncao Technology and Juncao Industry
Economic Value of Different Applications

- 300 tons forage: 20,000 USD
- 100 tons fresh mushroom: 300,000 USD
- 24 tons organic fertilizer: 6,000 USD
- 120 tons organic fertilizer: 30,000 USD
- 85.7 m³ fiberboard: 20,000 USD
- 75 tons kraft paper: 83,000 USD
- 182,000 kWh: 24,000 USD
Comprehensive and efficient utilization of **light, water and land**

Enabling circular production involving **plants, animals and mushrooms**

Improvement in **ecology, food and energy security**

Integration of **environmental, economic and social** benefits
1.1 Develop Juncao industry to enhance **Food Security** by establishing a more resilient high-quality protein food production system
Advantages of Juncao Technology

Utilization of marginal lands
Juncao grass can be planted at the non-arable lands, improving local supply capacity, so as to reduce the import of mushrooms and forage.

Strong resistance to extreme weather
Compare with silage corn and other crops, Juncao grass will survive better when encountering extreme weather including drought, flood, cold, strong wind, hail etc.

One time investment for long term benefit
In the tropical and subtropical areas, planting once can continue to harvest for more than 20 years with small investment and high profits

Short production cycle and high-quality products
Juncao grass can be utilized after 3 months of planting, requires no pesticides and has a high crude protein content, producing high-quality feed and mushrooms

User-friendly techniques
The simplified technology enables a wider participation of small-holder farmers in production
Mushroom

“Small yet Smart” livelihood projects

10 m²
mushroom trench

1200 kg
fresh mushroom for 4 production seasons

2400 US$
annual income

* Farm price of mushroom at 2 US$/kg

✓ > 56 commercial cultivation mushroom species
✓ High quality protein food
✓ Improve immunity
✓ Quick to produce
### Forage

<table>
<thead>
<tr>
<th></th>
<th>Signal Grass</th>
<th>Silage Corn</th>
<th>Giant Juncao Grass</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yield</strong></td>
<td>27.0 t/ha</td>
<td>52.5 t/ha</td>
<td>237.0 t/ha</td>
</tr>
<tr>
<td><strong>Crude Protein Content</strong></td>
<td>5.4%</td>
<td>7.8%</td>
<td>12.7%</td>
</tr>
</tbody>
</table>

- 1 ha Juncao grass
- 20 cattle or 200 goats

**Total Crude Protein Output/ha**

\[ \times 2.8 \]

\[ \times 20.6 \]
Juncao technology enables circular production involving plants, animals and mushrooms.
1.2 Juncao ecological management techniques to enhance Ecological Security as a quick, efficient, low-cost and sustainable ecological restoration measure
Juncao Grass Green Barrier Scenarios

- Island & Beach
- Rocky Desertification Area
- Desertification Area
- River Bank & Flood Land
- Abandoned Mine Land
- Saline & Alkaline Land
- Soil Erosion Area
Pingtan Island is one of the world's three major wind vents, which are as famous as Bermuda and the Cape of Good Hope. There are 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. Even *Casuarina equisetifolia* is difficult to survive at both sites.
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
Rwanda: the soil loss rate and water loss rate were reduced by **97.05-98.9%** and **80.0-91.9%** respectively.

<table>
<thead>
<tr>
<th>栽培模式</th>
<th>土壤湿重 (kg)</th>
<th>土壤干重 (kg)</th>
<th>与传统农作物相对减少土壤流失率 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>当地传统栽培农作物模式 model of local traditional crop cultivation</td>
<td>656.7</td>
<td>484.18</td>
<td>——</td>
</tr>
<tr>
<td>等高线巨菌草活篱笆套种农作物模式 Model of intercropping crops with Giant Juncao on contour line</td>
<td>27.18</td>
<td>20.25</td>
<td>95.80%</td>
</tr>
<tr>
<td>种植巨菌草模式 Model of planting JUNCAO</td>
<td>8.6</td>
<td>5.93</td>
<td>98.90%</td>
</tr>
</tbody>
</table>
Collapsing Hill
Juncao Grass Green Barrier
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
River bank erosion reduced by 70%
Wind Prevention and Sand Fixation with Juncao Technology

Reduce wind speed 46%~83%
Yellow River-River of Happiness
Carbon Fixation

300 t·hm⁻²

Giant Juncao Grass

150-200 m³·hm⁻²

Fiberboards

7.5-10 t·hm⁻²

Carbon Sequestration

Average value in the subtropical regions

Data Source: FAFU & collaborative enterprise

Calculation Method: IPCC First Order Decay Method
Save forest resources - Grass fiberboard

- Feeding
- Smashing
- Board making
- Drying
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.
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 °C
- easy to control, easy to eradicate

**No risk of invasion**
1.3 Develop Juncao industry to enhance *Energy Security*: high carbon sequestration, multifunctional biomass energy
<table>
<thead>
<tr>
<th>Types</th>
<th>Calorific Value (Cal/kg)</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Coal</td>
<td>5000</td>
<td>1</td>
</tr>
<tr>
<td>Giant Juncao Grass</td>
<td>3580</td>
<td>0.71</td>
</tr>
</tbody>
</table>

The electricity generated from 1 ha Juncao grass equals to 60 tons raw coals.

Using average yield in the subtropical regions.
2. Latest Research Progress of Juncao Technology
2.1 Juncao Grass and Mushroom Germplasm Innovation and Breeding

2.1.1 Germplasm Collection and Protection

Collection & Cultivation
Juncao germplasm were collected and cultivated in the resource center (130 different species)

Protection
Jujuncao (Giant Juncao grass) certified as a new plant species (Cenchrus fungigraminus)


Measurement and comparison with similar cultivars
2.1.2 Data-Science-Guided Intelligent Breeding

Screening of Genomic Targets

Potential Breeding Targets

Genomic Editing & Hybridization

Phenotyping

New cultivars

Germplasm Engineering

Screening Methods

Genomic maps
Screening of Genomic Targets: High-Impact Researches

Genome of JUJUNCAO
Plant Comm. (IF=10.5), 2023

Cistrome of JUJUNCAO
Nucleic Acids Res. (IF=14.9), 2023

Genomic Database
Plant Biotech. J. (IF=13.2), 2023
2.1.3 Multi-omics Database to Curate the Targets

Integration of Multi-omics Data
- genomics
- epigenomics
- transcriptomics
- proteomics
- metabolomics

Open-Database (FAIR-framework)
- Findable
- Accessible
- Interoperable
- Reusable

(submitted to Mol. Plant.)
Germplasm Engineering for the Identified Targets

**Tissue Culture & Regeneration**
Standard processes have been established to perform stable tissue-culture and plant regeneration for species e.g., JUJUNCAO and LVZHOU

**Gene Editing**
We are setting up transgenic and genome-editing tools to engineer the identified genomic targets, to improve the resistance to cold and drought.

Tissue culture for JUJUNCAO
*(Cenchrus fungigraminus)*

Genomic engineering for LVZHOU
*(Arundo donax)*
New mushroom varieties - Case: *Macrocybe gigantea*

Key steps for cultivation of *Macrocybe gigantea* (*Golden Mountain Giant Mushroom*) with Juncao grass.
Application in CAR – for high temperature environment
3. Promotion Progress in Developing Countries in Year 2023
Sent 23 Batches 59 experts from FAFU to 16 Countries

- Africa: Rwanda, South Sudan, Tanzania, CAR, Uganda, Ethiopia, South Africa
- Asia: Thailand, Philippine, Laos
- South Pacific: Fiji, Papua New Guinea, Vanuatu, Micronesia
- Latin America: Mexico
- Middle East: UAE

Project implementation, feasibility study, conference, etc..
Training-in China

• 8 international training courses/seminars full-sponsored for developing countries with total **249** participants from **35** countries trained at China National Juncao Center
Training-outside China

• National training courses/seminars fully-sponsored with total more than 2,000 participants
African Regional Workshop on Juncao Technology in Rwanda on Feb, 2023

Second African Regional Workshop on Juncao Technology in Ethiopia on Dec, 2023
International Study Tour on Juncao Technology in China on June, 2023
4. Provide Sustainable Development Solution for Small Island Countries
How to achieve sustainable development of Small Island Countries in the face of vulnerability in the economic, social and environmental fields?

Disadvantages:

- Limited arable land
  - improve land utilization efficiency
- Limited population and consumer markets
- high end product, high quality VS large volume
- Limited fund
- small investment favored production, quick return
- Less resistance to natural disasters
- strong resistance species, and quick recovery
- Excessive dependence on international trade/external resources
  - locally planted and processed easily
- High cost of communication, energy, transportation and lower development level of infrastructure
- higher profit product and integrated with tourism
Juncao technology provides an effective and comprehensive solution that plays a positive role in the implementation of the 13 Sustainable Development Goals (SDGs).

The promotion and application of Juncao technology aims at helping developing countries further enhance their independent development capabilities.
China-Fiji Juncao Technology Demonstration Center / China-Pacific Island Countries Regional Center
Eight Functions of Juncao Technology Demonstration Base:

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

The role of the China-Pacific Island Countries Juncao Technology Demonstration Center:

From resources, techniques, talents, to industry chain, to provide training and technical support for small island countries, to realize the sustainable supply of local raw materials, sustainable land development, sustainable ecological management, and sustainable science and technology development.
Four Strategies

- People-centered and capacity building as priority
- Simplification of technology
- Poverty reduction via developing industry
- Adaptation of technique, extension model and talents nurturing

推广模式
Extension Model

一看就懂、一学就会、一做就成
Easy to Learn, Easy to Practice, Easy to Succeed

10平方米菇农场 年产菇1200公斤
10m² mushroom farm
1,200kg fresh mushroom per year
More than **2,000** Fijians trained
- Local mushrooms have acquired different trademarks
- Juncao technology effectively alleviated the shortage of green fodder in the dry season and beefed up the animal husbandry development.
- Local vocational schools setting up demonstration bases of Juncao technology
Rural women learn science of growing mushrooms

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

Sixty-four women from the villages of Naitasiri, Saumaka, and Drauliba 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 inter-crop with a quick turnover to fill the gap in the period that our yacon crops are maturing,” said Ledua Verett, the advisor to the village community council of Naavucini.

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 Verett said that the farming of oyster mushrooms, which would solely be an activity for the women, and the planting of yacon by the men, were in line with the Naavucini 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 Iiu Daumivalu said she was pleased to see the interest emanating from rural communities for mushroom production.
www.juncao.org

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Thank You!

DATA source from V.P. Dongmei Lin, Prof. Zhanxi Lin, Prof. Fangjie Zhu, Dr. Jin Li, Ms Fan Yan, Ms Yulin Wan, Mr. Hui Lin, Mdm Xiuming Cao, Mr. Hengyu Zhou
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