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System Thinking Bamboo for Climate Change Mitigation, Green Development and Sustainable Communities

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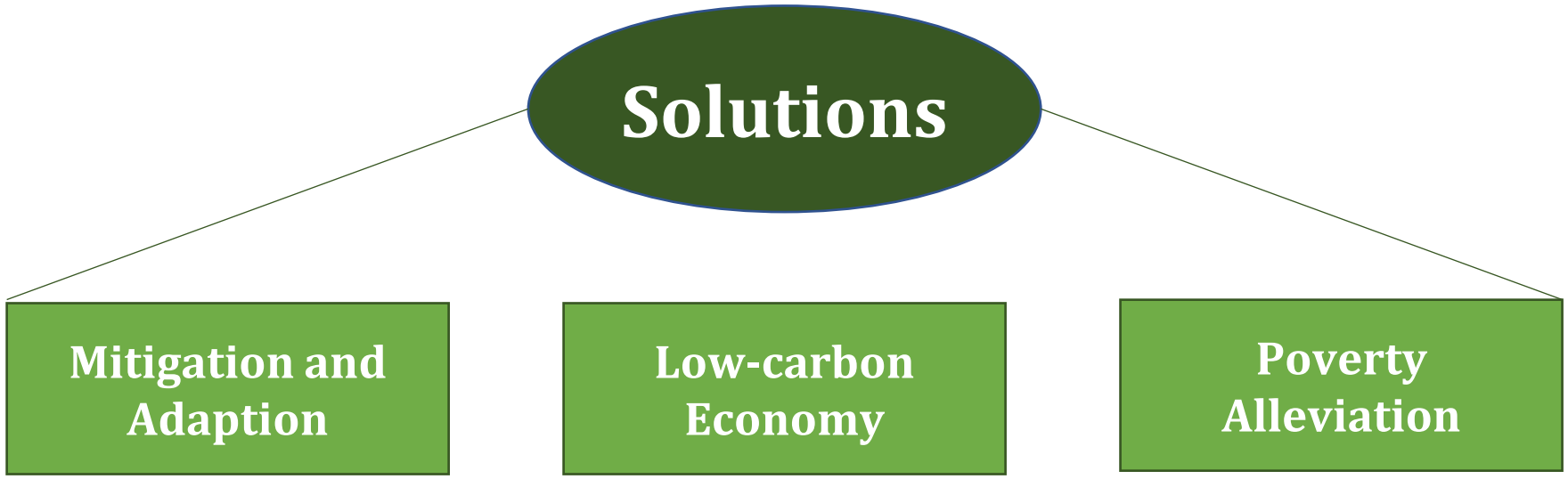
Challenges: Climate change, Energy Crisis and Poverty



With bamboos, we can do…

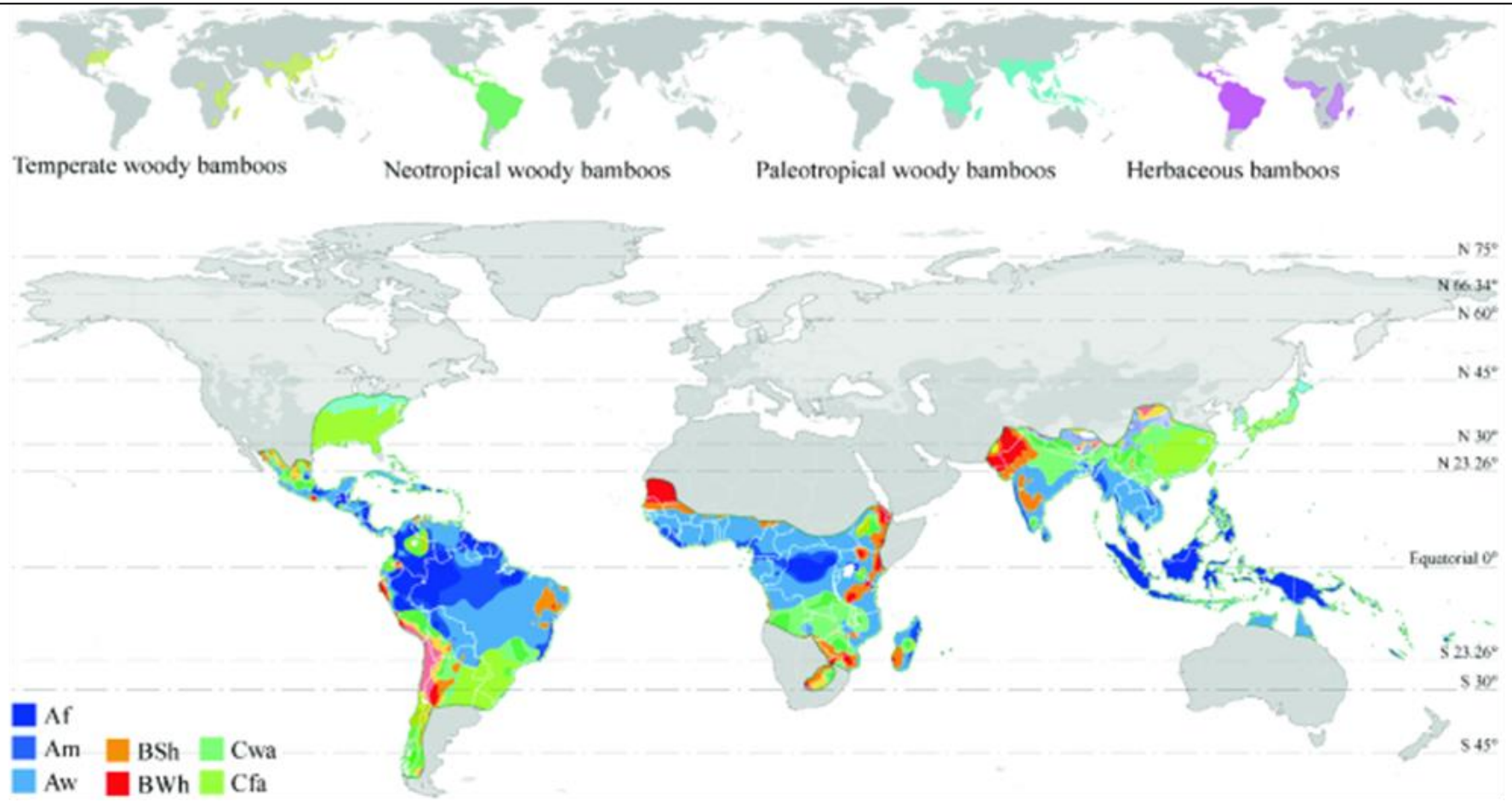
- Increase carbon sink
- Reduce carbon emission

- Develop outdoor recreation
- Replace high-energy-consumption products, such as plastic, steels etc.

- Increase incomes of farmers
- Promote economical development

Global Distribution of Bamboo Forests

I. Global Distribution of Bamboo Forests

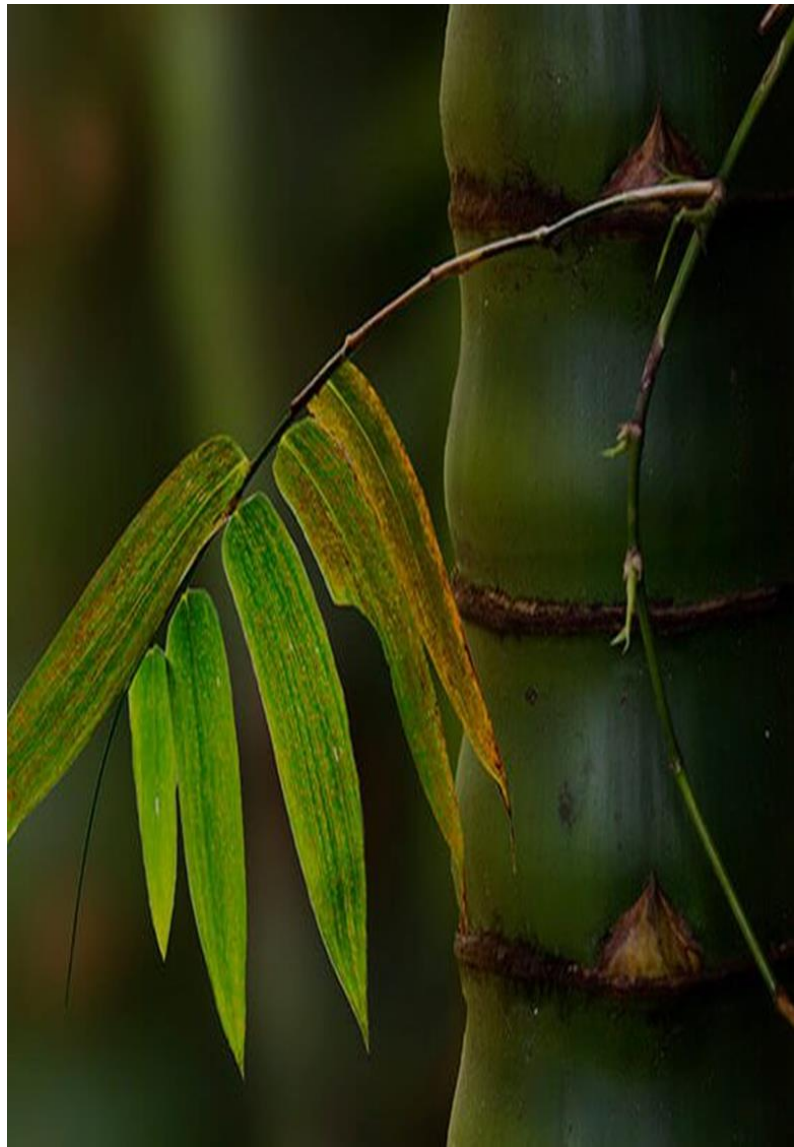


Huang, Z. (2019). Introduction. In: Application of Bamboo in Building Envelope. Green Energy and Technology. Springer, Cham

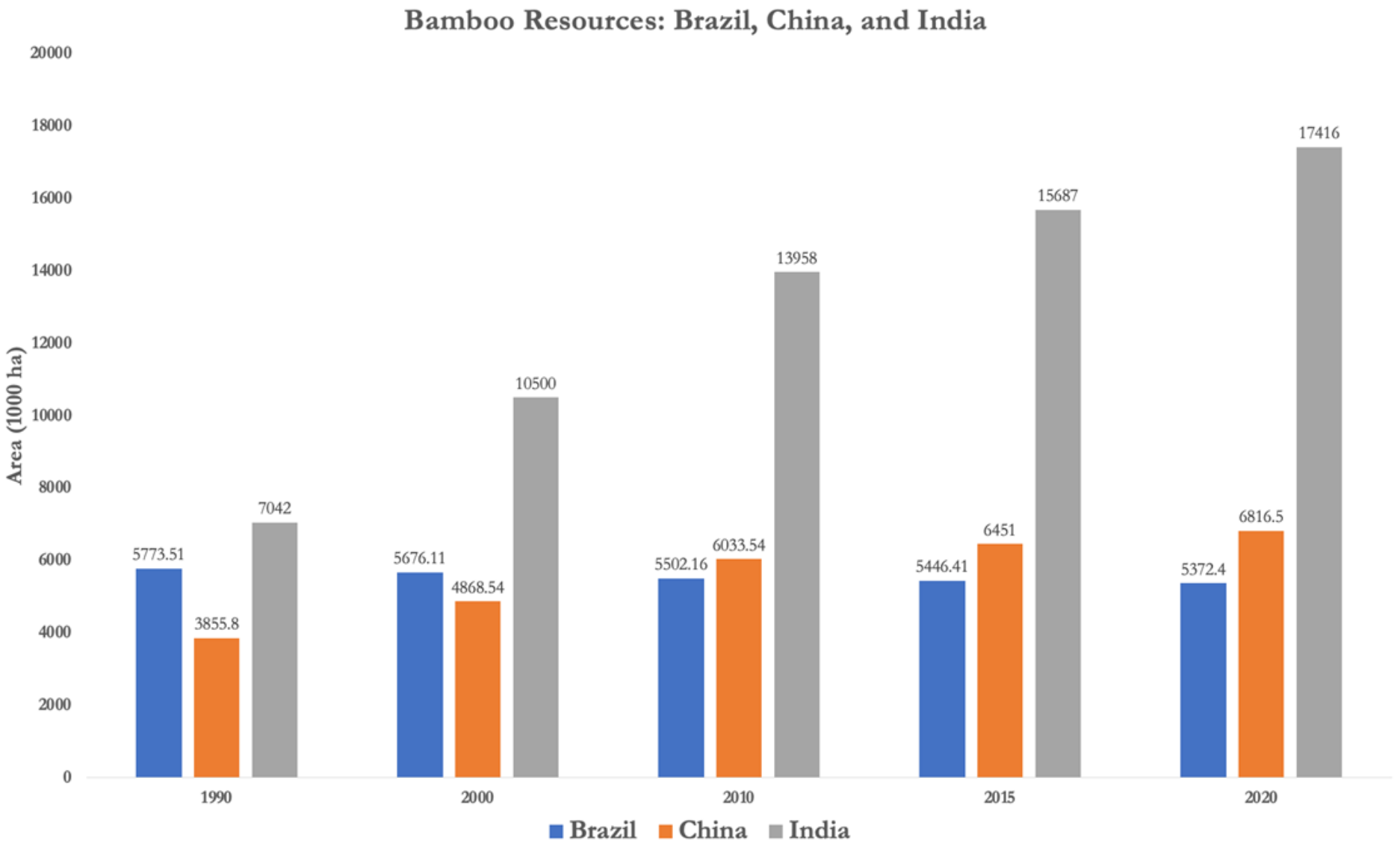
I. Global Distribution of Bamboo Forests

Table 1. Area of bamboo by region and subregion, 2020

Region/Subregion	Bamboo Area (1000 ha)
Eastern and Southern Africa	3984
North Africa	30
Western and Central Africa	634
Total Africa	**4648**
East Asia	7005
South and Southeast Asia	17872
Western and Central Asia	0
Total Asia	**24877**
Total Europe	**0**
Total North and Central America	**125**
Total Oceania	**0**
Brazil	5372
Remaining subregions in South America	17
Total South America	**5389**
World	**35039**



I. Global Distribution of Bamboo Forests

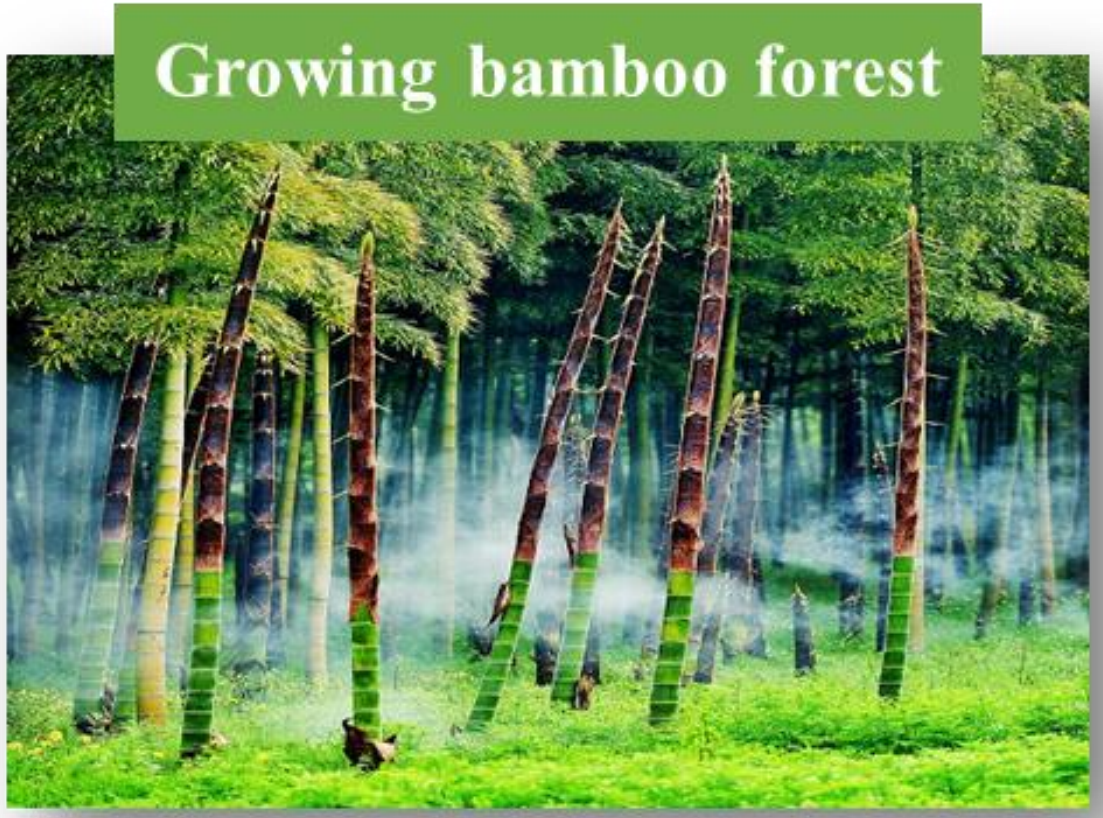


Mitigation and Adaptation for Climate change
Bamboo as a prominent carbon-sequestration forest

II. Mitigation and Adaptation for Climate change
Bamboo as a prominent carbon-sequestration forest

1. Fastest-growing plant on the earth!

- **Grows maximum 1 m day^{-1} .**
- **Reaches 10-30 m within 2-3 months.**



II. Mitigation and Adaptation for Climate change
Bamboo as a prominent carbon-sequestration forest

2. The most renewable forest/stand

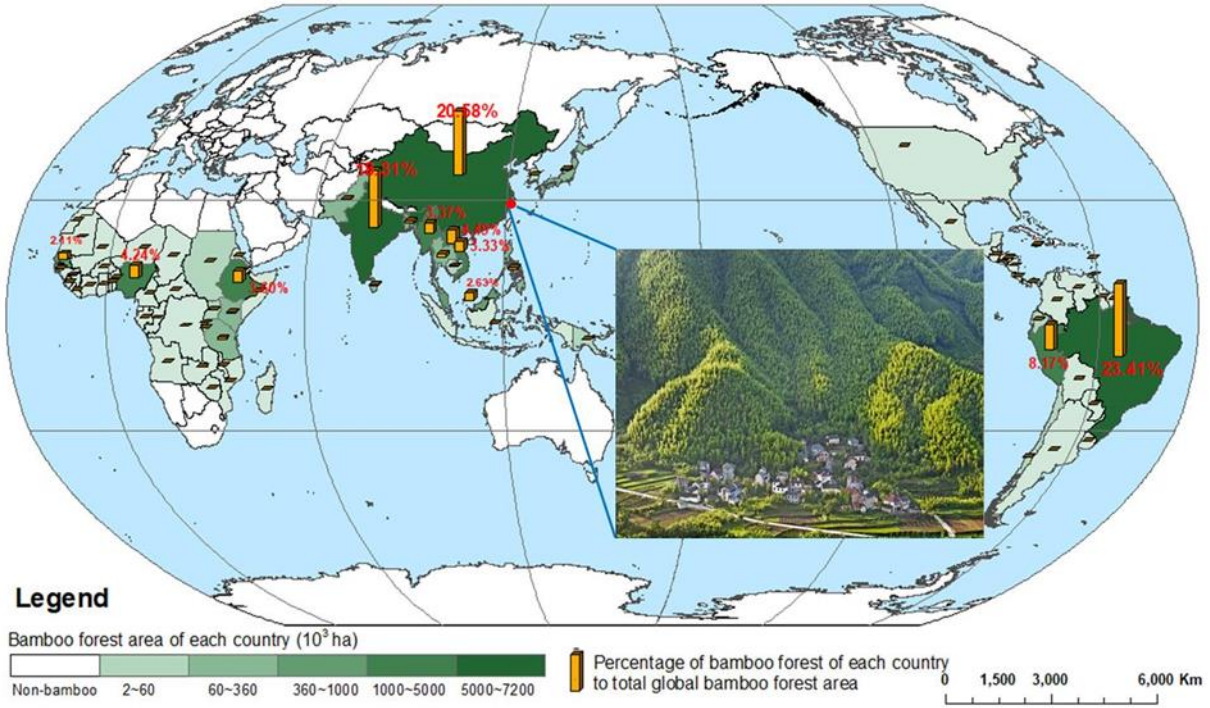
- **Culm-rhizome-shoot system allows simultaneous biomass translocation (selective harvest old bamboos) without changing the function and structure of the forest ecosystem (grow new bamboo shoots).**
- **Stable rhizome/underground stem system**

II. Mitigation and Adaptation for Climate change
Bamboo as a prominent carbon-sequestration forest

3. Widely distributed worldwide

Bamboo worldwide:

- 107 genus and more than 1,300 species.
- Cover 32 million ha, accounting for 0.8% of total forest area. “the second largest forest resource”
- Main distribution: Asia-Pacific region, Africa and South America.



Bamboo in China:

- 34 genus, 534 species
- 6.01 million ha, accounting for 19% of total bamboo forest area worldwide.

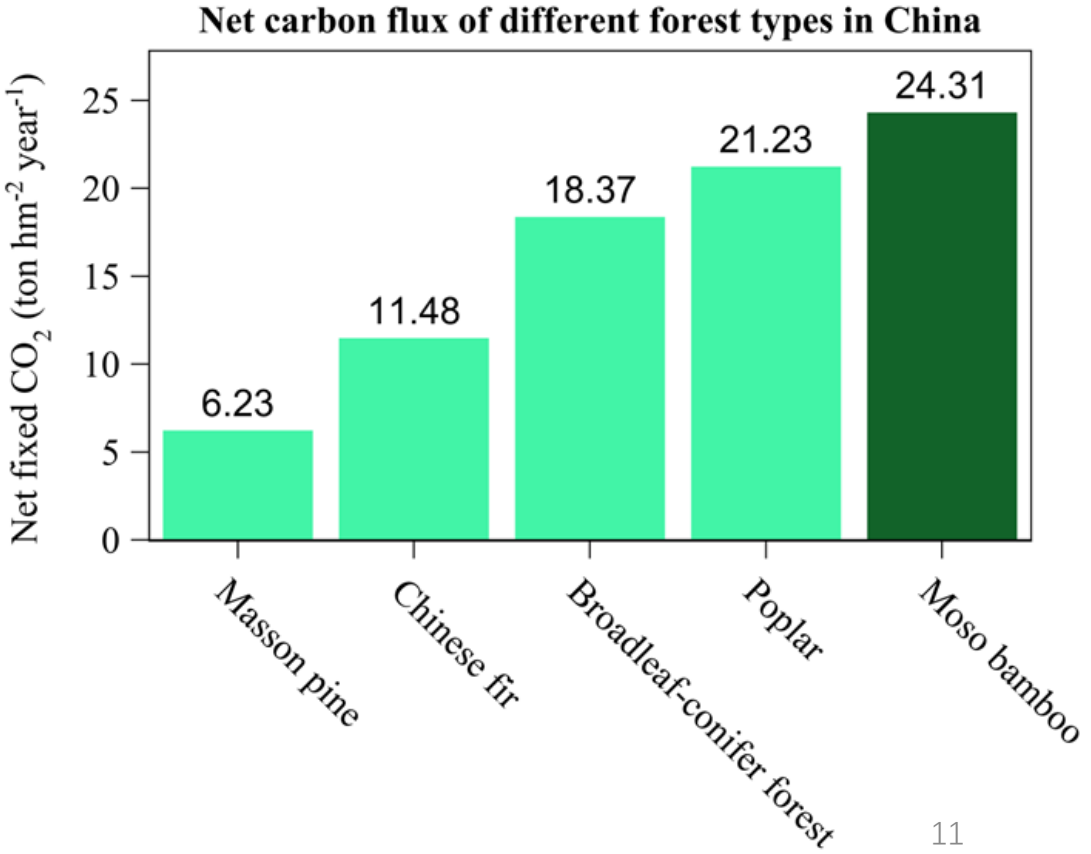
II. Mitigation and Adaptation for Climate change
Bamboo as a prominent carbon-sequestration forest

4. Excellence in carbon-sequestration

Moso bamboo

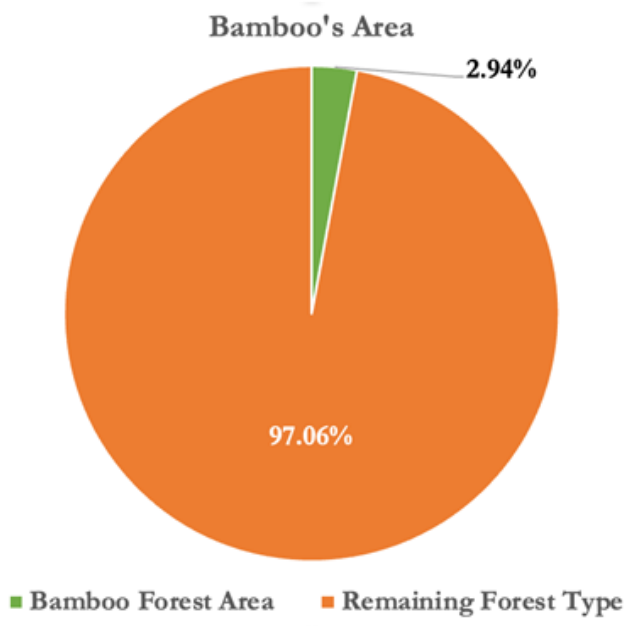
- Highest
- ~4 times Masson pine
- ~2 times Chinese fir

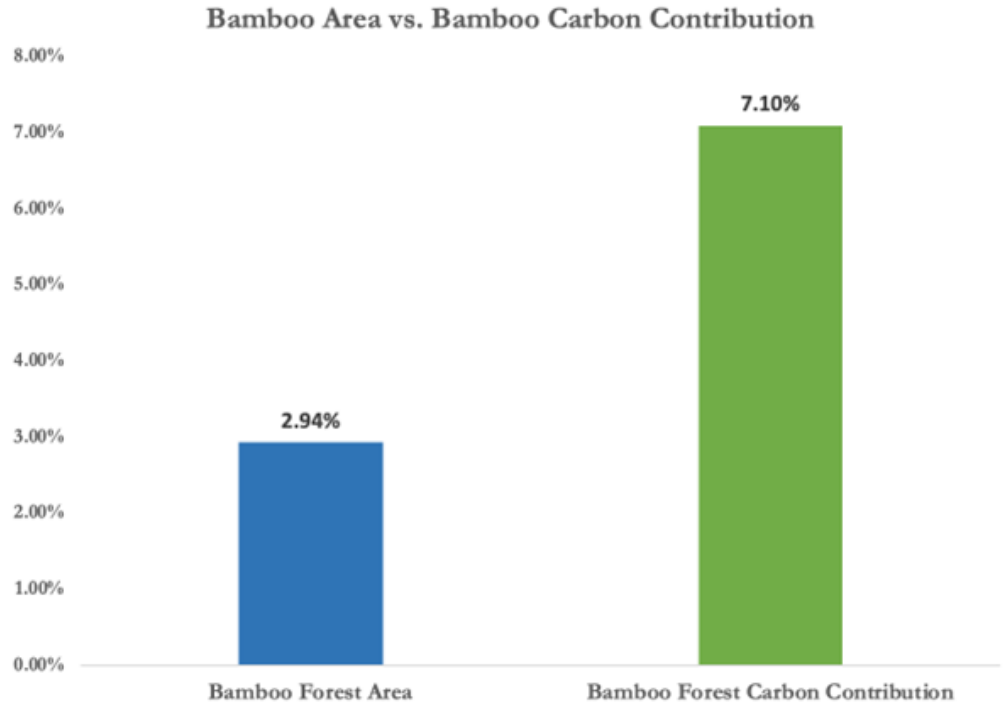
Eddy covariance tower in a Moso bamboo forest, Anji County, Zhejiang



II. Mitigation and Adaptation for Climate change
Bamboo as a prominent carbon-sequestration forest

4. Excellence in carbon-sequestration





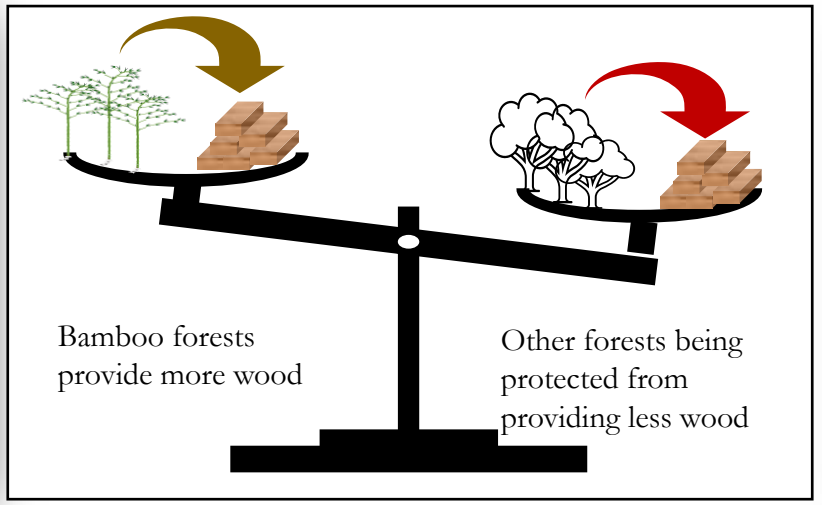
With bamboo, we can obtain more carbon credits with less forest land.

Green Development with Bamboo

III. Green Development with Bamboo

Bamboo as a substitute for wood

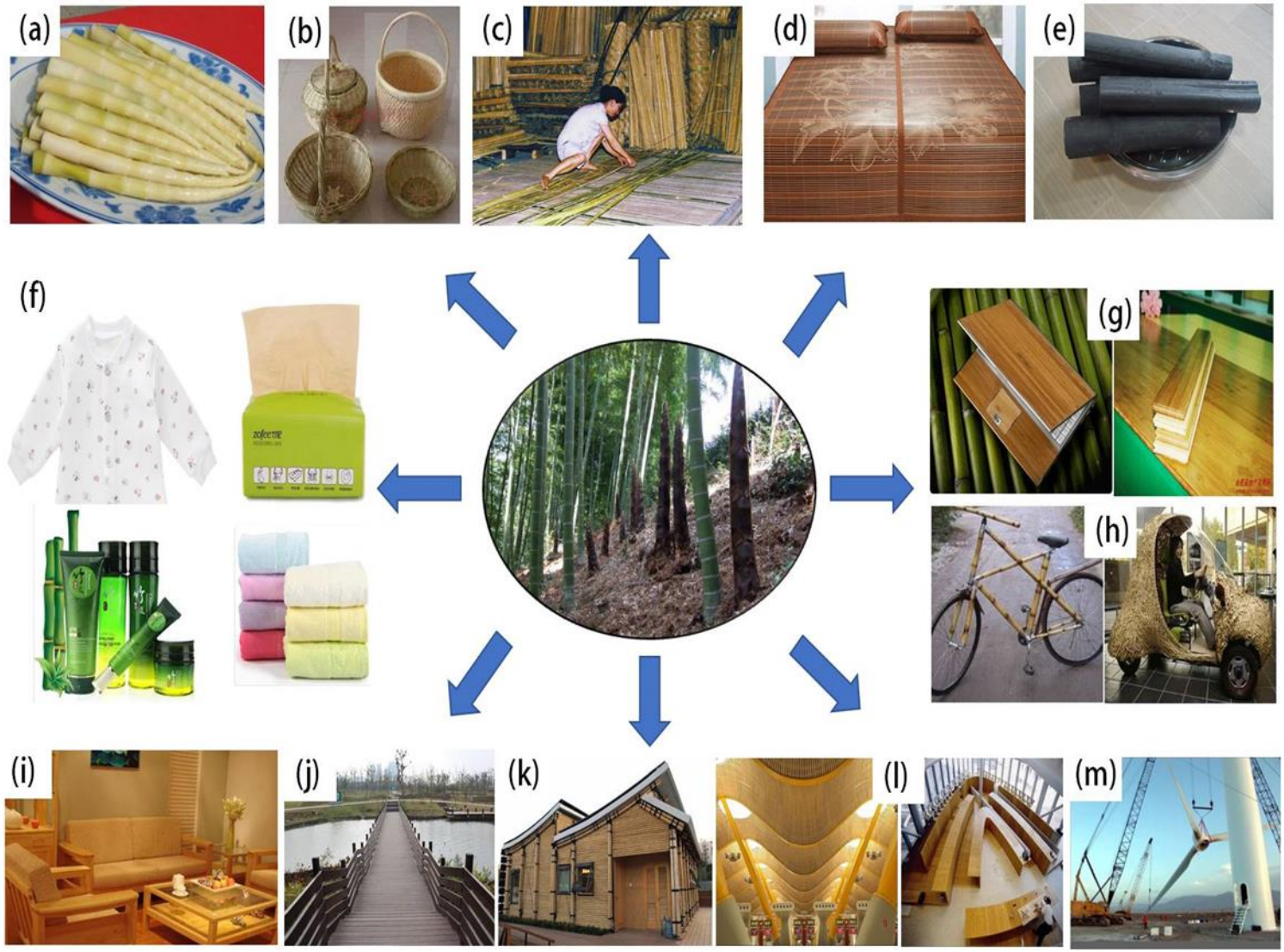
- Prevent deforestation
- Protect forest resources
- Prevent biodiversity loss
- Prevent soil disturbances



III. Green Development with Bamboo

Bamboo products-full of variety (3000+)

(a) bamboo shoots;
(b) bamboo weaving;
(c) bamboo slabs;
(d) bamboo mats;
(e) bamboo biochar;
(f) bamboo-fiber fabric, facial tissues, and makeup;
(g) bamboo decorative material;
(h) bamboo vehicle;
(i) bamboo furniture;
(j) bamboo floor;
(k) bamboo buildings;
(l) bamboo waiting hall;
(m)bamboo wind turbine blades.



III. Green Development with Bamboo

Bamboo as an alternative to Plastics

- Degradable
- Low-carbon product

III. Green Development with Bamboo

Emission reduction by substituting bamboo for plastics

Carbon footprint of bamboo-powder film bags:

- Additives emit the most **(78.87%)**
- Transportation has the least contribution **(1.6%)**

Stage	Process	Carbon emission （kg CO_2-eq/kg） and proportion (%)
Transportation	Raw bamboo powder， PBAT and starch	0.0568 （1.6%）
Production process	Mixing, feeding, stirring, heating, shearing, cooling, drying, vibrating screen, vacuum suction machine, storage tank, suction, blowing film, heating ring, winding, unwinding, printing, etc	0.6890 （19.52%）
Add-ons	PBAT, Starch, Film bag	2.7844 （78.87%）
Product carbon footprint	Life-cycle carbon emissions	3.5303

III. Green Development with Bamboo

Emission reduction by substituting bamboo for plastics

- Comparison of Carbon Footprints Between Plastic Bag and Bamboo-Powder Film Bag
- 4.6797 (kg CO_2-eq/kg) reduced from using bamboo
- **57%** drop in carbon emission

Product	Carbon Footprint (kg CO_2-eq/kg)	Data sources
Plastic Bag	8.2100	CPCD, China Products Carbon Footprint Database
Bamboo-Powder Film Bag	3.5303	This study
Emission Reduction	**4.6797**	-

III. Green Development with Bamboo

Since 2001, our laboratory have conducted numerous programs on bamboo forest carbon sequestration. **We contribute to:**

1. Specify bamboo as an enormous carbon sink.

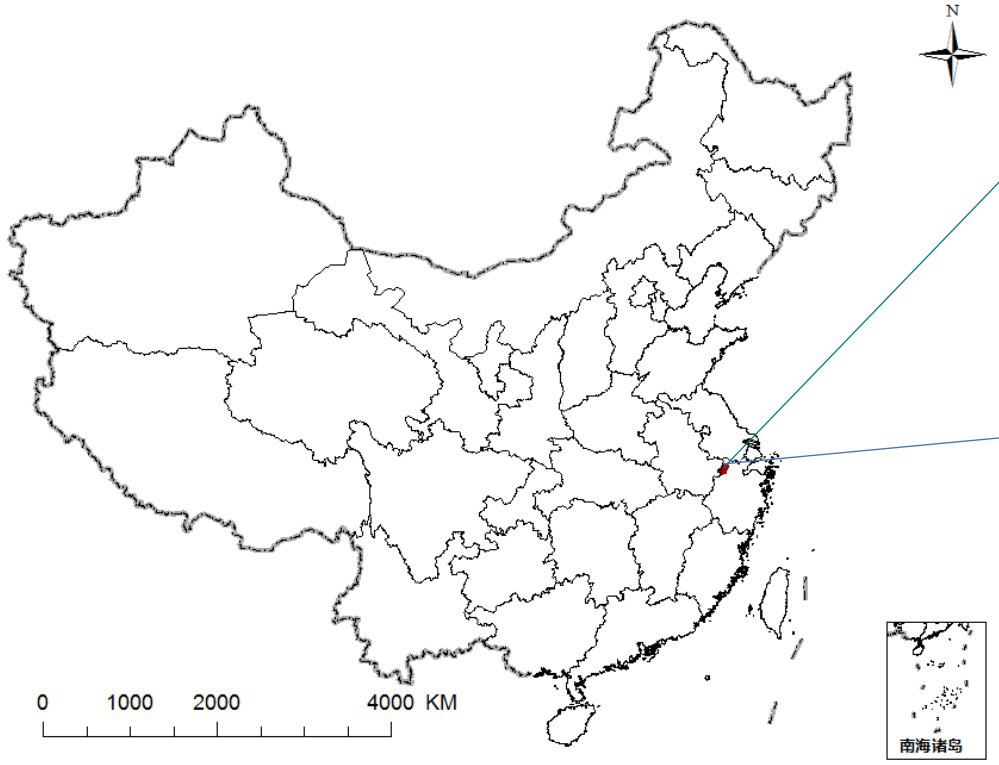
2. Precisely monitor bamboo forests and carbon stock in various spatiotemporal scales.

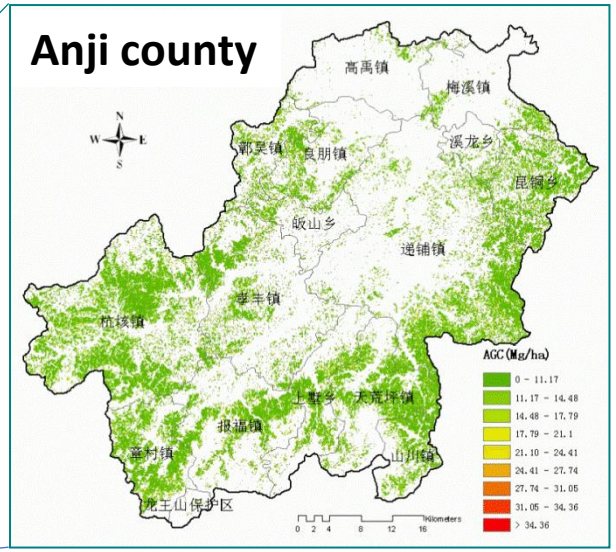
3. Develop techniques on adding carbon sink and reducing carbon emission.

4. Develop methodologies to Verified Carbon Reduction and Verified Carbon Standard for bamboo forests.

Bamboo for sustainable communities

IV. Bamboo for sustainable communities





Population: 0.464 million

Area: 188,600 ha

Bamboo Forest Area72,000 ha.
(38.18% of the Total area)

IV. Bamboo for sustainable communities

- Anji was made as a model county for setting up the standard of the “Beautiful China” .

- Some scenes in the film “Crouching Tiger, Hidden Dragon“ were also taken in Anji.

IV. Bamboo for sustainable communities

1st in China

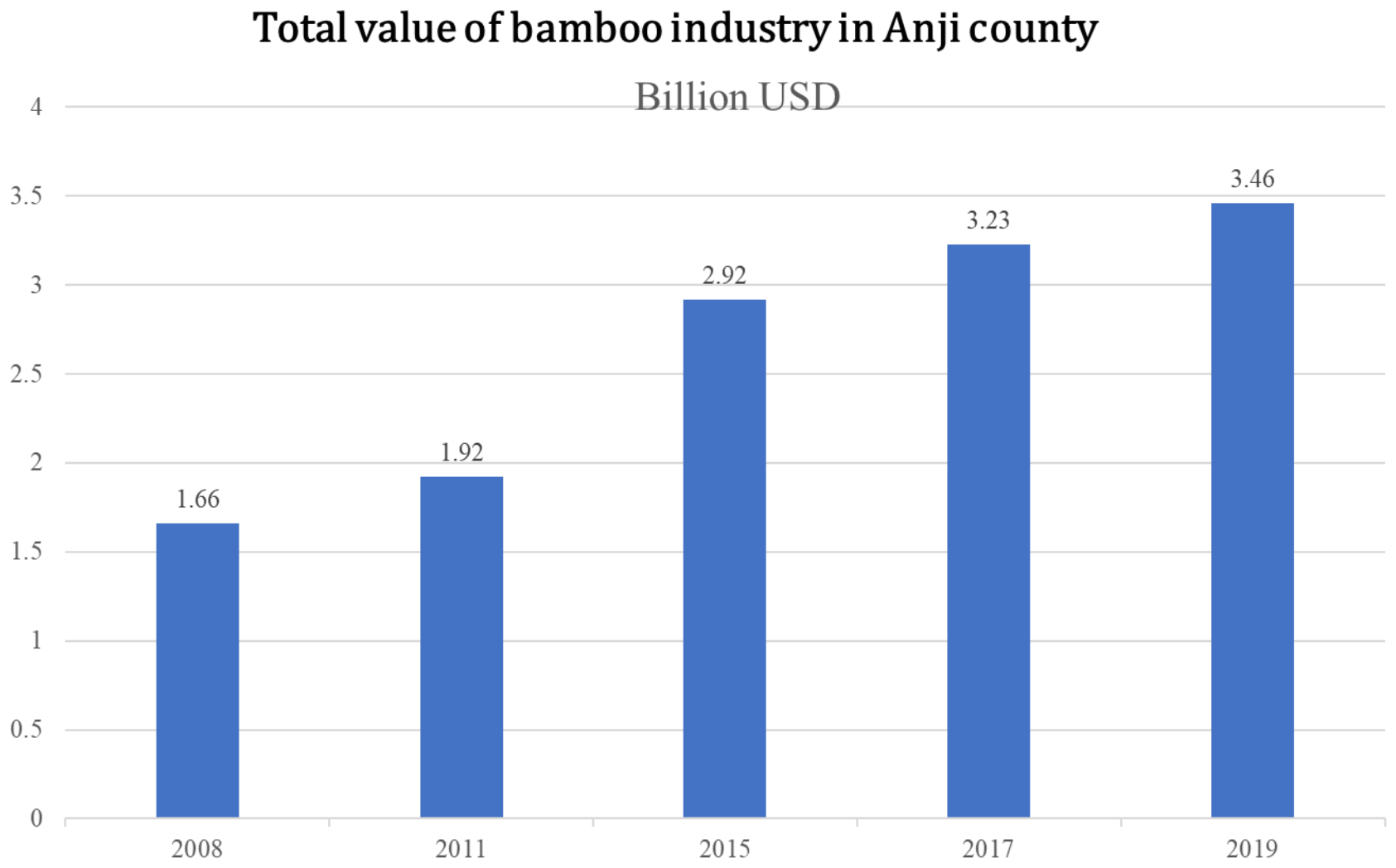
- Standing bamboo quantity
- Annual output of commercial bamboo,
- Annual output value of bamboo processing industry
- Annual export volume of bamboo products
- Comprehensive economic strength of bamboo industry are all ranked 1st in China

IV. Bamboo for sustainable communities

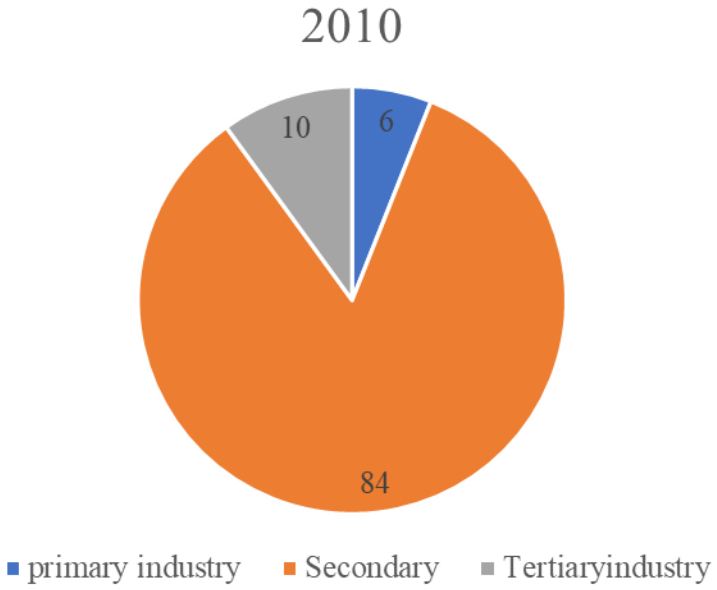
Year	Bamboo production value	Increase rate	Primary industry	Increase rate	Secondary industry	Increase rate	Tertiary industry	Increase rate
2010	2		0.12		1.69		0.19	
2013	2.6	36%	0.12	0%	1.87	10.4%	0.61	221%
2015	2.9	11.8%	0.12	0%	2	7.8%	0.78	28%
2017	3.2	10.5%	0.1	0%	2.1	6.2%	1	28%
2019	3.46	6.2%	0.1	0%	2.2	4.7%	1.16	16%

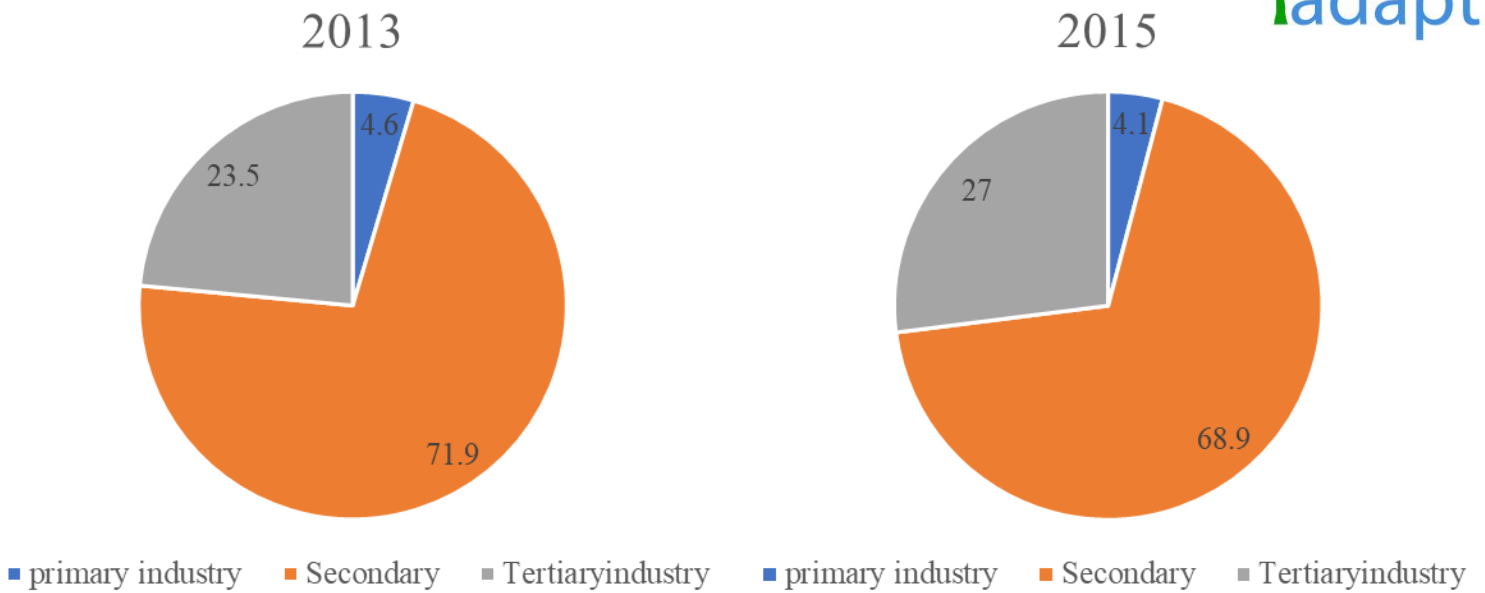
The ecological and cultural products of bamboo are developing fast

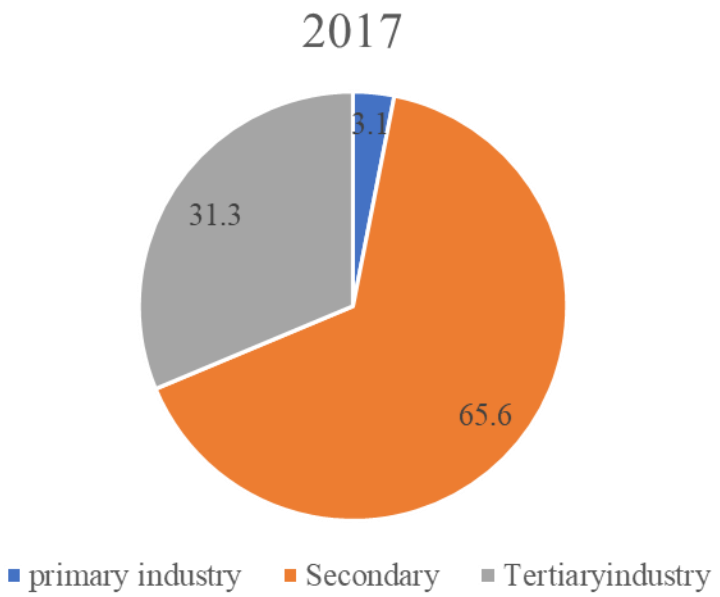
IV. Bamboo for sustainable communities

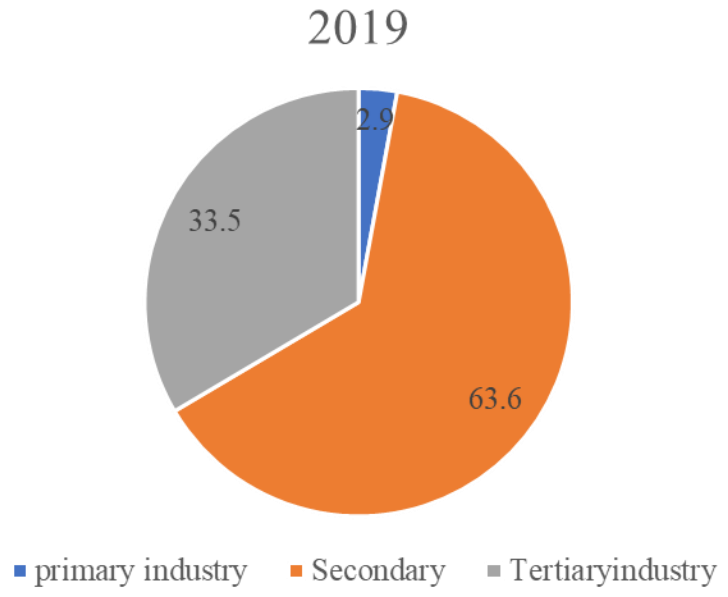


IV. Bamboo for sustainable communities









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