Bamboo Resources for new usage in Japan

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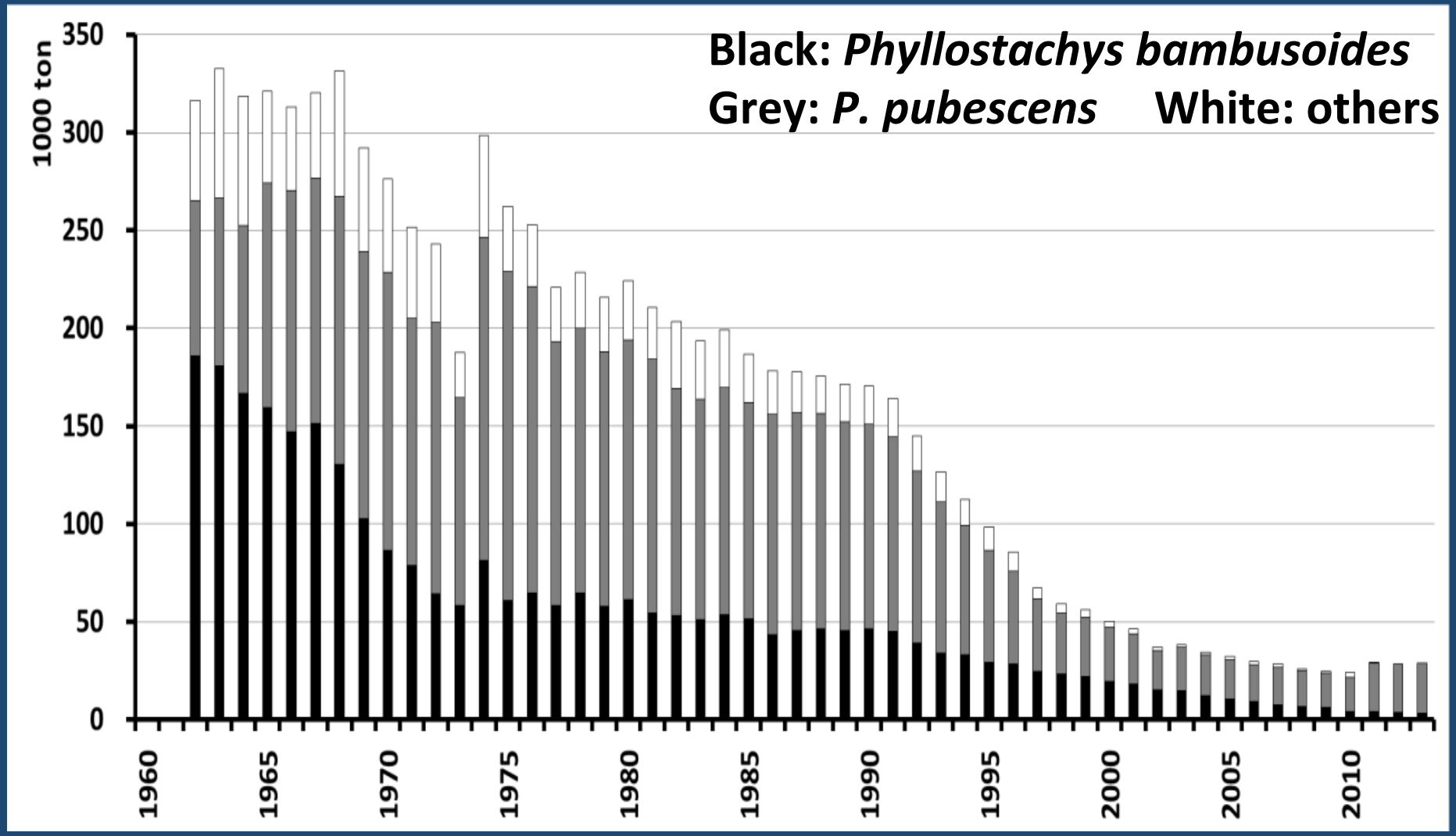
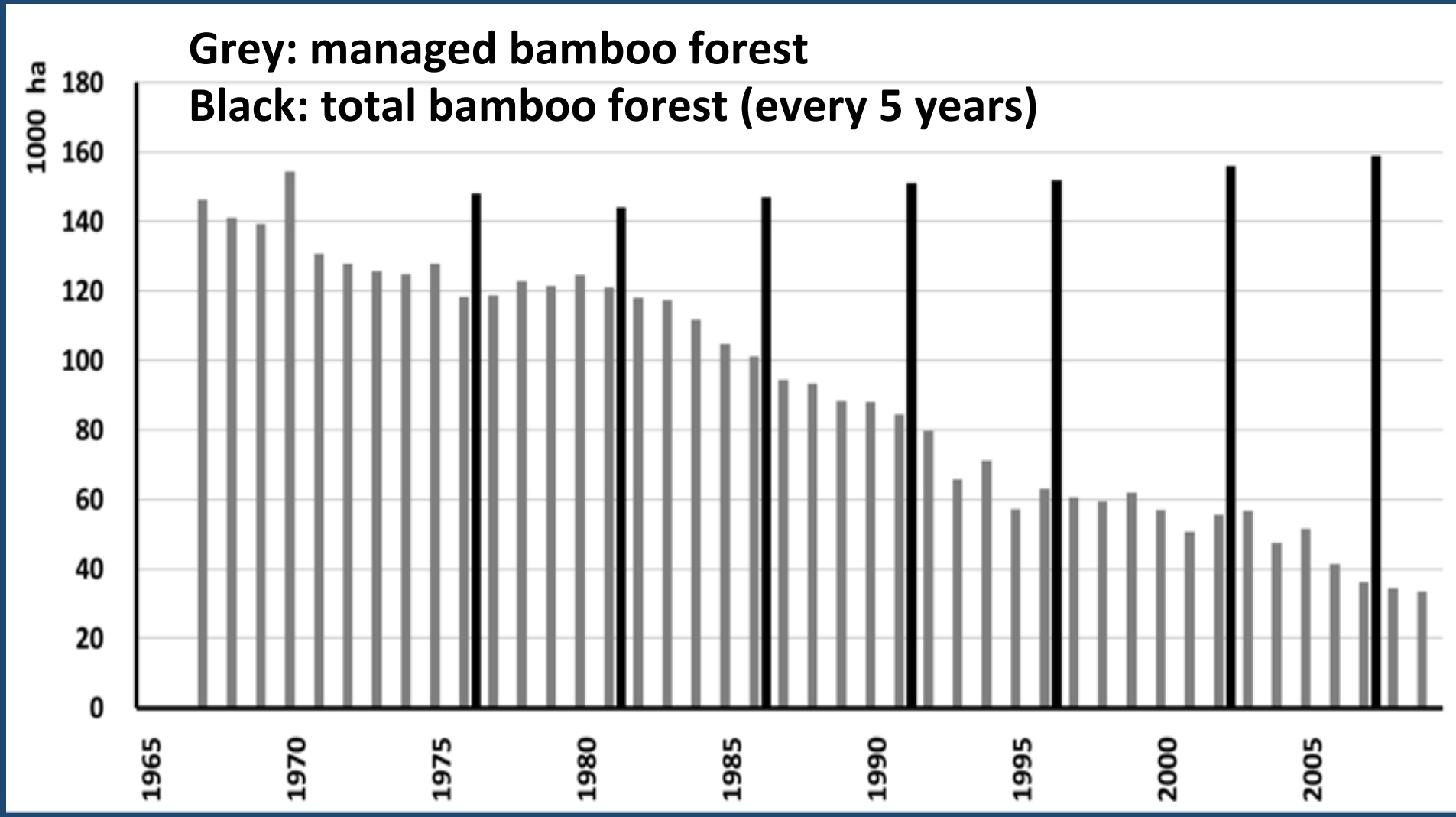
Long history with bamboo in Japan

- Japanese has been continuing the good relationship with bamboo.
- This relationship produce a lot of characteristic Japanese culture like tea ceremony etc..
- However in these few decades Japanese relegate this relationship by the change of lifestyle.
- These change influenced to the bamboo forest management and production (decrease of bamboo timber production, increase of abandoned bamboo forest area).
- These change were accelerated by the increase of the import of bamboo products.
- On the other hand, abandoned bamboo forest spread naturally to the surrounding abandoned lands.



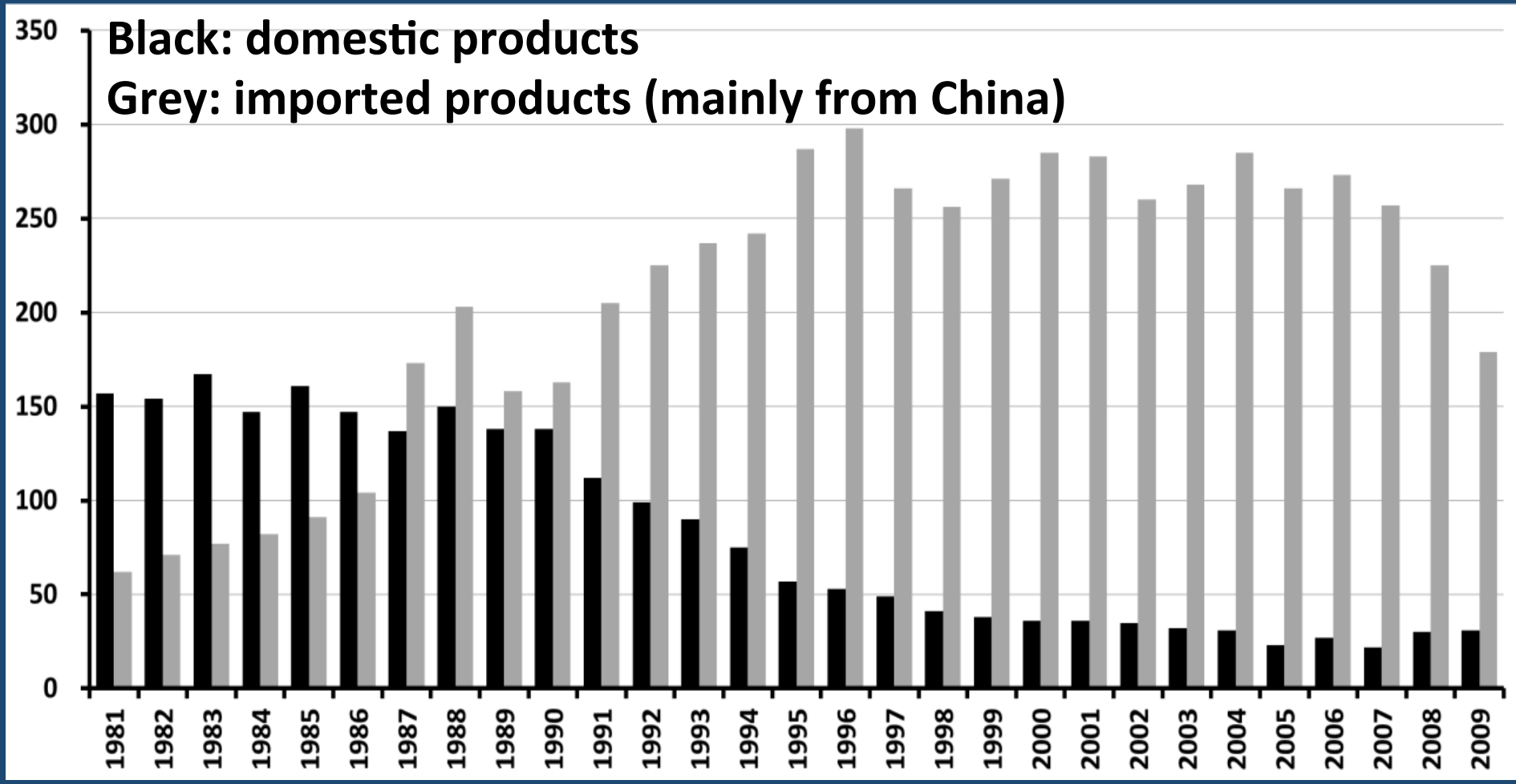
Statistical change of bamboo timber production in Japan (Japan Forestry Agency 2015)

Decrease between 1969 to 1973 occurred
by the flowering of *P. bambusoides*.



Statistical change of bamboo forest area in Japan (Japan Forestry Agency 2015)

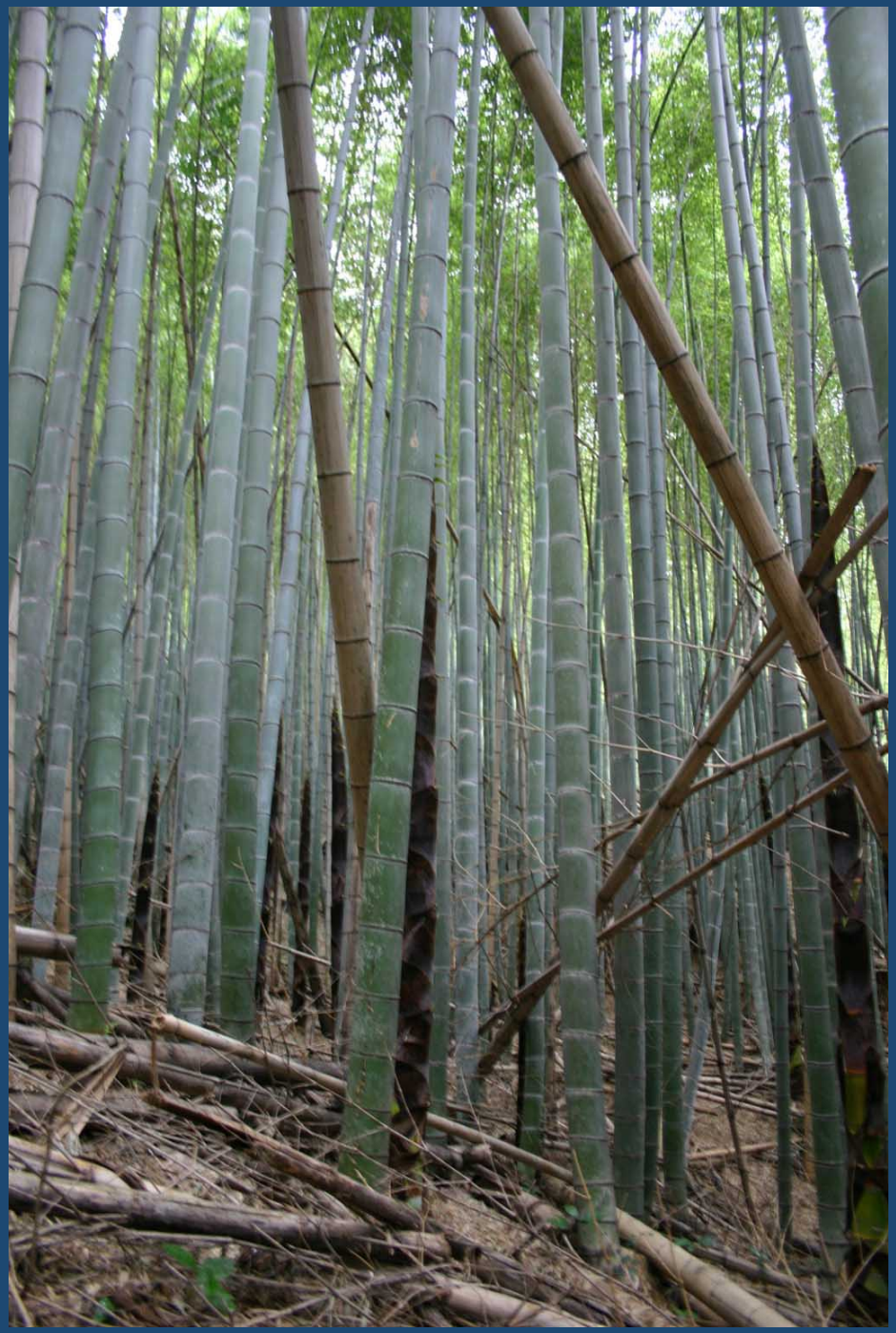
Managed bamboo forest is decreasing and naturalized bamboo forest are increasing



Statistical change of bamboo shoot products in Japan (1,000 ton) (Japan Forestry Agency 2015)

During 1990's imported boiled bamboo shoot exceeded the domestic production and farmers lost the will to produce.

Well-managed bamboo forests in Kyoto, Japan (left: timber forest, right: bamboo shoot forest)



Deterioration of bamboo forest by the loss of management

Traditional usage of bamboo in Japan

- As a sacred plant
- As a materials for primary industry
- As a material for woven products
- As a materials for traditional culture
- As a materials for musical instruments
- As a materials for traditional and daily application
- As a materials for food and wrapping
- As a materials for modern application
- For the horticultural usage

etc.

Bamboo use as a sacred plant

Bamboo use for primary industries

Bamboo use for woven products

Bamboo use for traditional culture

Bamboo use for music and sacred entertainment

Bamboo use for daily application: Japanese houses

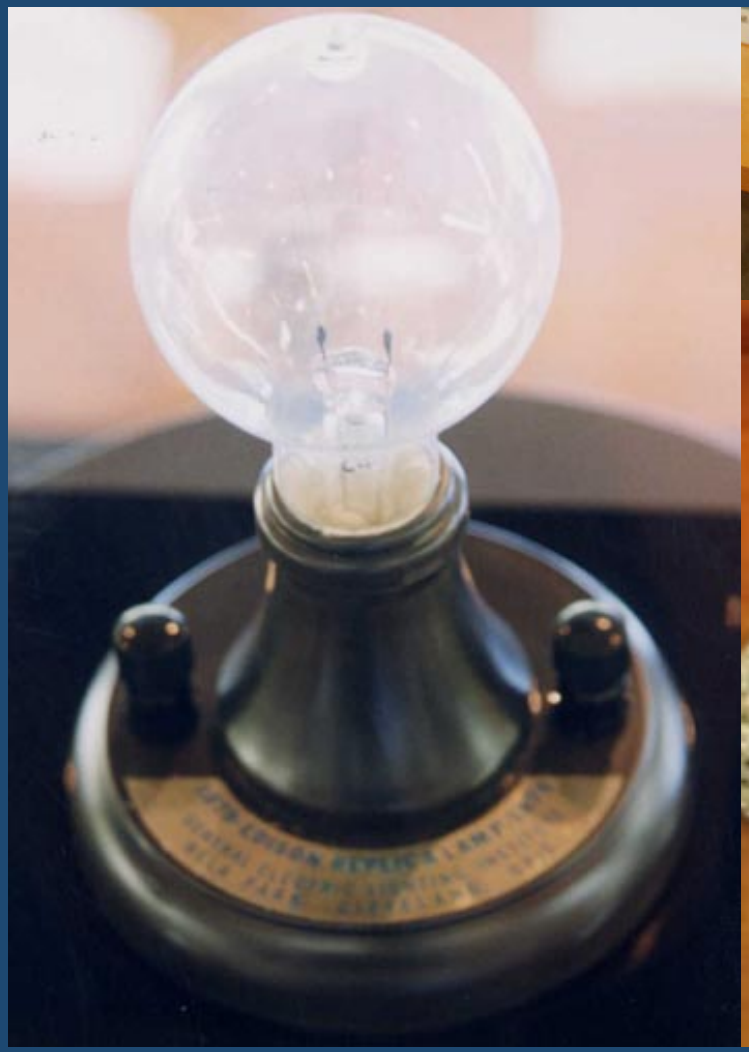
Bamboo use for daily application:
High quality knitting needles using Moso bamboo

Bamboo shoot as Japanese food material

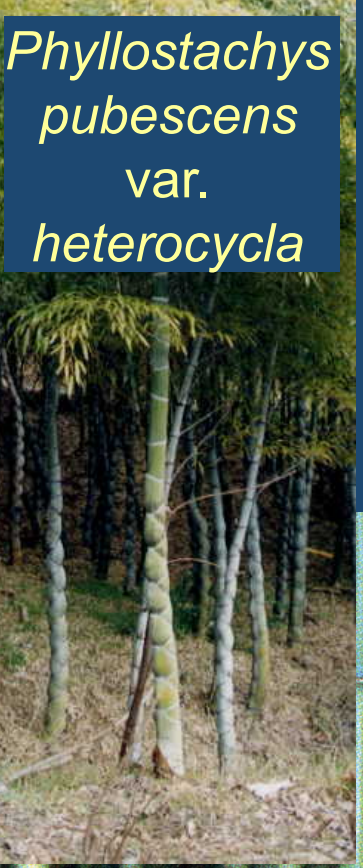
http://www.kinsuitei.co.jp/cgi-bin/cgi_diary12/masterboard.cgi

Bamboo leaf use for wrapping

Bamboo use for modern application

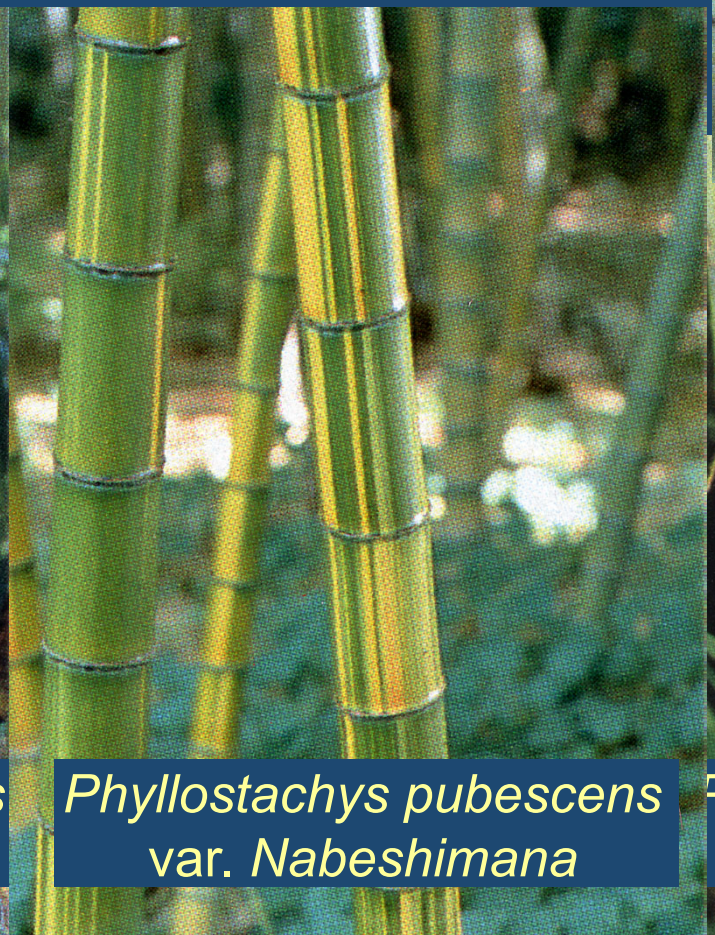


Bamboo horticultural species

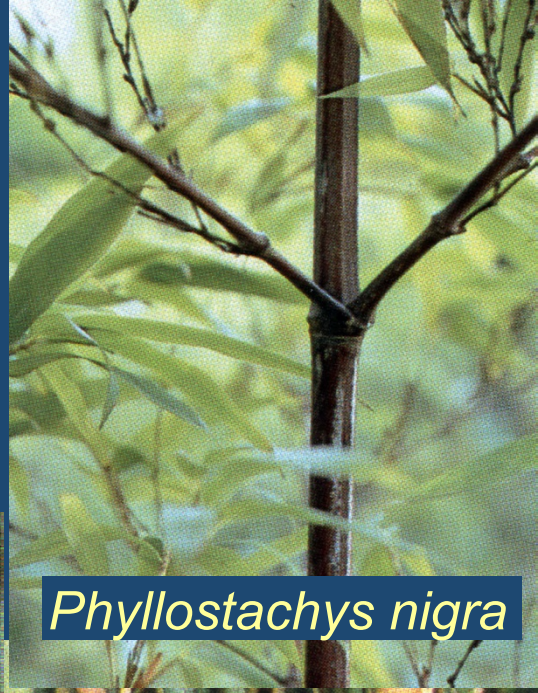


Phyllostachys pubescens var. *heterocycla*

Phyllostachys bambusoides var. *castilloni-inversa*



Phyllostachys pubescens var. *Nabeshimana*



Phyllostachys nigra

Pseudosasa japonica var. *Tsutsumiana*

Bamboo garden in Kyoto

New trials to promote the use of bamboo resources

- Decline of traditional use of bamboo resources causes the degradation of ecological value of bamboo forest and trials to find new usage to reevaluate bamboo resource.
- At present a lot of people not from the bamboo industries are trying to find the new usage of bamboo resources and to restore the environment of Japan.
- However many industries forget the first motivation to recover the Japan's environment after the development of the techniques because of the profitability.

Six categories of bamboo usages as new material resources (1)

- **Timbers**:

  Uses as laminated bamboo focusing on the effects of antibacterial and deodorant activities mainly by using the surface part of culm

- **Charcoal and vinegar**:

  versatile materials like for soil improvement, deodorizer, healing materials, cosmetics, materials for audio equipment, desiccant etc. including industrial uses as sharcoal powder

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TAKE Create Hagi

Six categories of bamboo usages as new material resources (1)

- **Timbers**:

  Uses as laminated bamboo expecting the effects of antibacterial and deodorant activities by mainly using the part of culm surface

- **Charcoal and vinegar**:

  Versatile materials like for soil improvement, deodorizer, healing materials, cosmetics, materials for audio equipment, desiccant etc. including industrial uses as charcoal powder

New speaker products using bamboo fiber, charcoal and plant opal from bamboo leaves by Panasonic

http://car.watch.impress.co.jp/docs/news/20140225_636884.html

Six categories of bamboo usages as new material resources (2)

- **Fibers**:

  coarse level: road pavement chips, compost, etc.

  fine level: paper & pulp, cloth, food materials, reinforcement of industrial products etc.

  nanoparticle level: bio-plastic, bio-glass etc.

- **Extracts**:

  traditional uses as wrapping materials of leaves & sheaths and bamboo leaves tea and alcohol

  new uses as medicines, cosmetics etc. expecting the antibacterial effects

Plant for bamboo fiber production in Japan

Shoes using bamboo and glass fibers

Use of bamboo fibers for foods

Six categories of bamboo usages as new material resources (2)

- **Fibers**:

  coarse level: road pavement chips, compost, etc.

  fine level: paper & pulp, cloth, food,
  reinforcement of industrial products etc.

  nanoparticle level: bio-plastic bio-glass etc.

- **Extractions**:

  Traditional uses as of leaves and sheaths for wrapping materials & bamboo leaves for tea etc.

  New uses as medicines, cosmetics etc. expecting the antibacterial effects

Use of bamboo extraction aiming at antibacterial activity

Six categories of bamboo usages as new material resources (3)

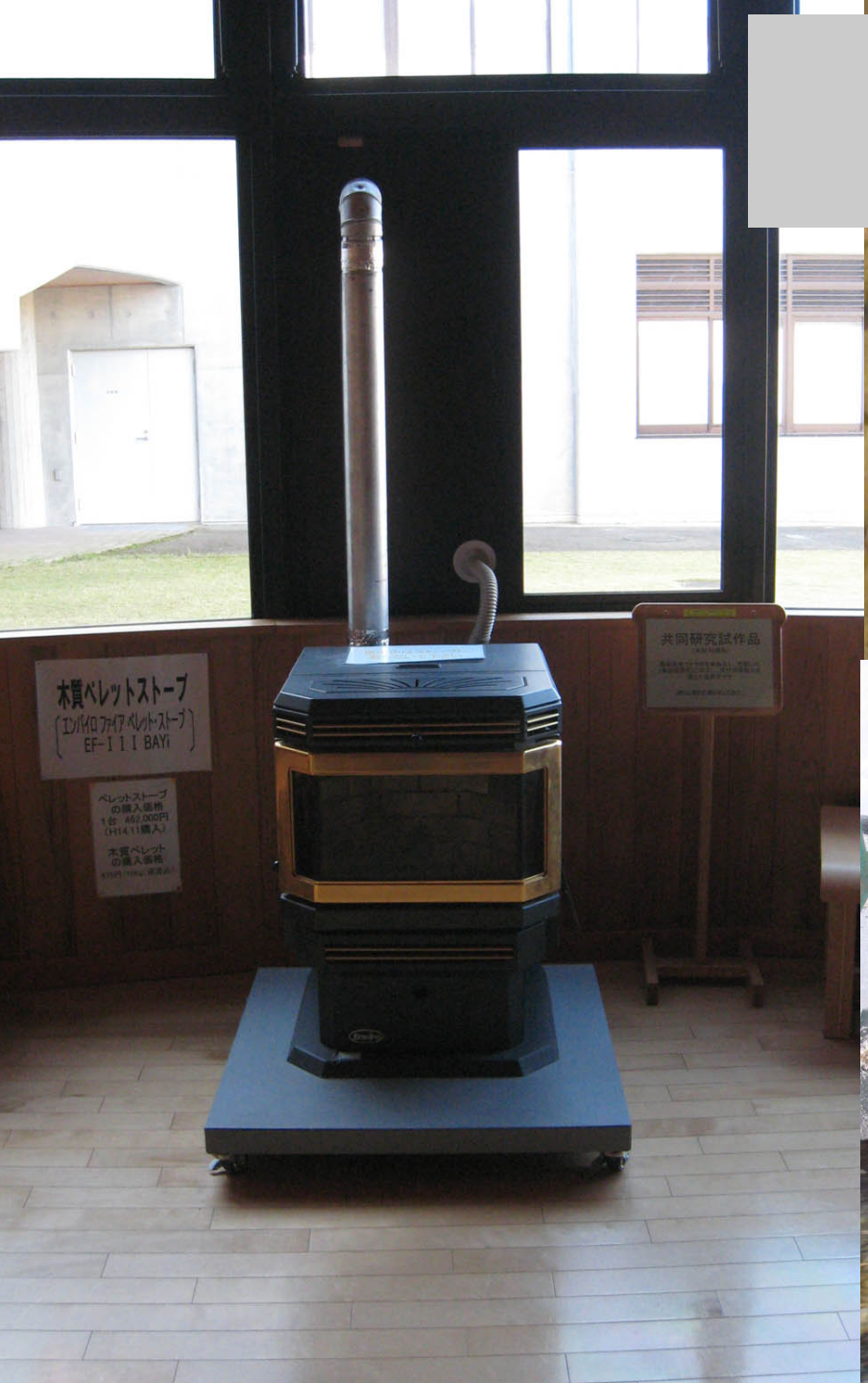
- **Energy**:

  A lot of kind of trials are done like charcoal (popular products in Japan but lack of domestic standard), pellet (10% higher calorie than woody materials), mixed burning of chips in electric power plants, use for bio-gas, materials for bio-ethanol etc.

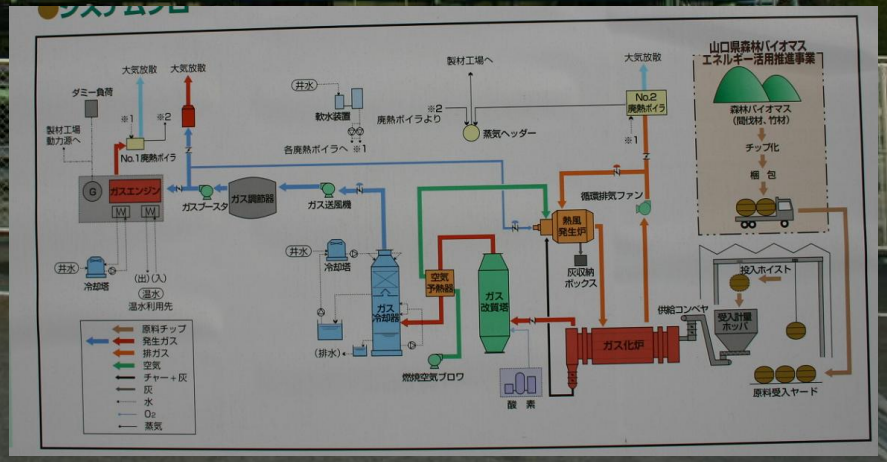
- **Environmental capital resources**

  Bamboo is recognized as helping to maintain favorable environmental conditions and supporting specific biodiversity. Plans are in Japan to evaluate these properties toward environmental capital resumption in bamboo forest management.

Production and use of bamboo pellet



Trial of bamboo bio-gas power generation



Machines developed to produce fine bamboo powder (nano scale)

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Dwarf bamboos as the indigenous species in Japan are used for the re-vegetation of developed sites

Efforts toward system development for new bamboo resources usage

- According to the encouragement of central government many local governments are trying to use bamboo as a new resource.
- As typical local government and private companies, there are some examples like

  Mifune Town of Kumamoto pref. (bamboo registration system), Haruno Town of Kochi pref. (production of bamboo plywood), Miyazu of Kyoto pref. (trial to produce the bamboo ethanol), Chuetsu Pulp & Paper Co. (production of high-quality bamboo paper), etc..

- Central government also continue the effort to develop new harvesting machines and related methods based on research at the national research institute of forestry.

Construction of bamboo forest registration for effective bamboo resource uses in Mifune Town, Kumamoto, Japan

Grapple developed for effective bamboo culm harvest

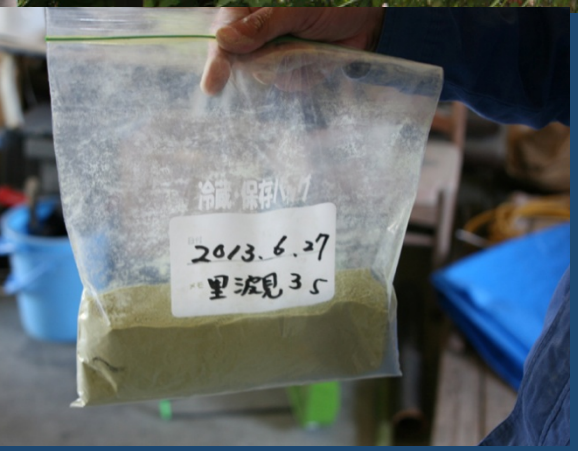
Trials of Miyazu city to require the profitability of farmers (1)

- The high cost of Japanese labor necessitates the development of effective harvesting system and the use of bamboo resources to manufacture products with high added value. Efforts to secure profitability are important in creating high incomes of bamboo farmers.
- Companies planning to use domestic bamboo resources as a material on a commercial basis seek to purchase the resource as cheaply as possible. As the current unit price of bamboo culm is 3 – 5 JPY (2.5 – 4.2 cents in USD) per kilogram, farmers earn around 60 – 175 JPY (0.51 – 1.48 USD) per culm. Well-managed Moso bamboo forests yield around 1,000 culms per hectare annually, producing a yearly farming income of only 500 – 1500 USD per hectare. This income is very low for Japan.

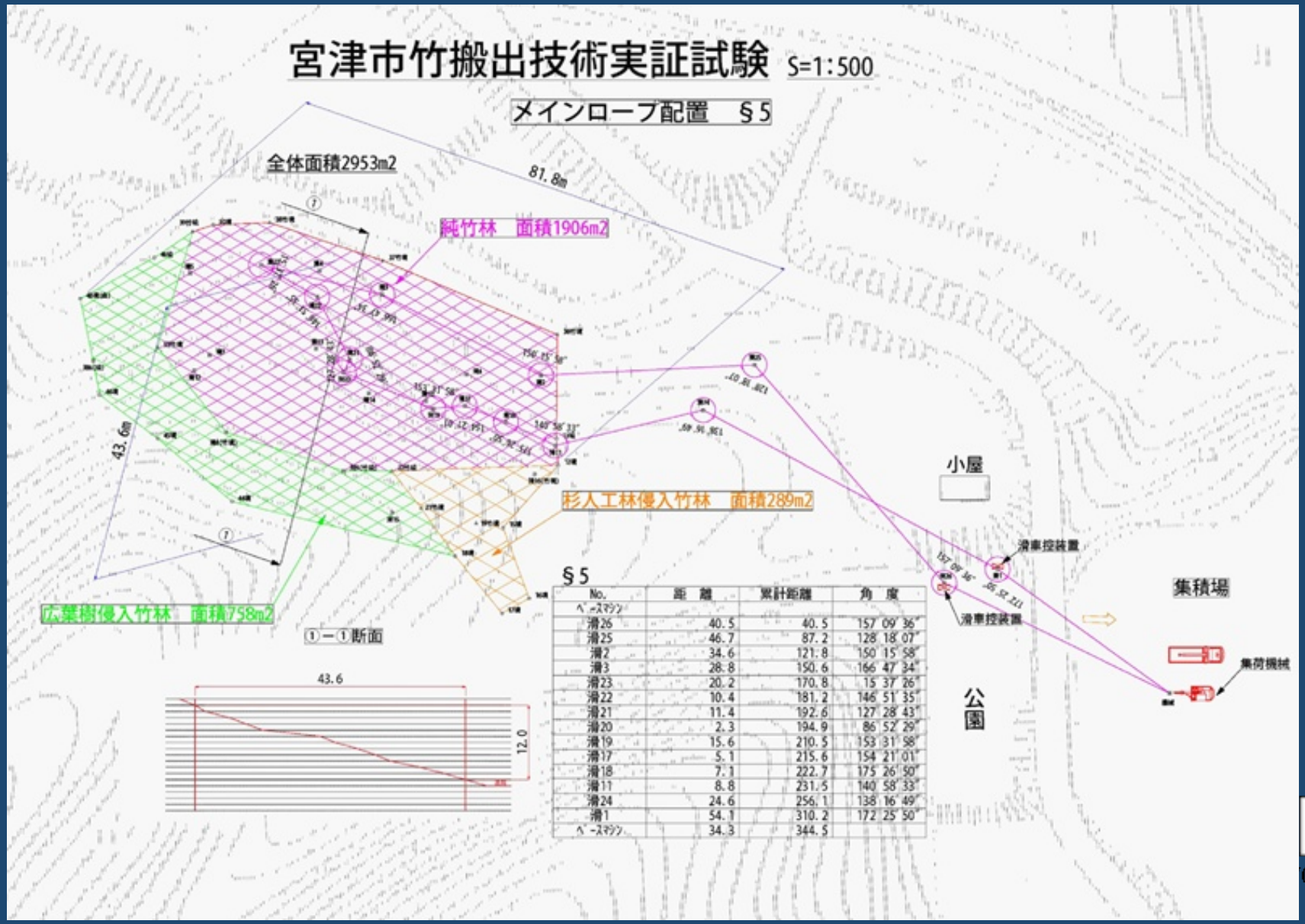
Trials of Miyazu city to require the profitability of farmers (2)

- One important solution is cascade resource use, as seen in efforts by Miyazu City. Miyazu also try to develop an effective bamboo harvesting system to reduce harvesting labor costs (Miyoshi and Shibata unpublished).
- In the process of cascade resource use, the green bamboo culm surface is important to obtain green powder which is highly valuable in the production of bamboo extracts. The remaining bamboo is processed to produce chips. However, bamboo chips will in future be used as a material for methanol production.
- Miyazu City aims to increase farming incomes to at least 500 – 700 JPY (4 – 6 USD) per culm.

Plant for new bamboo resource use in Miyazu, Kyoto, Japan



Cable yarding challenge for bamboo culm harvesting at Miyazu, Kyoto, Japan



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No.	距離	累計距離	角度
ヘッドスマシン			
滑26	40.5	40.5	157°09'36"
滑25	46.7	87.2	128°18'07"
滑2	34.6	121.8	150°15'58"
滑3	28.8	150.6	166°47'34"
滑23	20.2	170.8	15°37'26"
滑22	10.4	181.2	146°51'35"
滑21	11.4	192.6	127°28'43"
滑20	2.3	194.9	86°52'29"
滑19	15.6	210.5	153°31'58"
滑17	5.1	215.6	154°21'01"
滑18	7.1	222.7	175°26'50"
滑11	8.8	231.5	140°58'33"
滑24	24.6	256.1	138°16'49"
滑1	54.1	310.2	172°25'50"
ヘッドスマシン	34.3	344.5	

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Relationship between export distance and cost

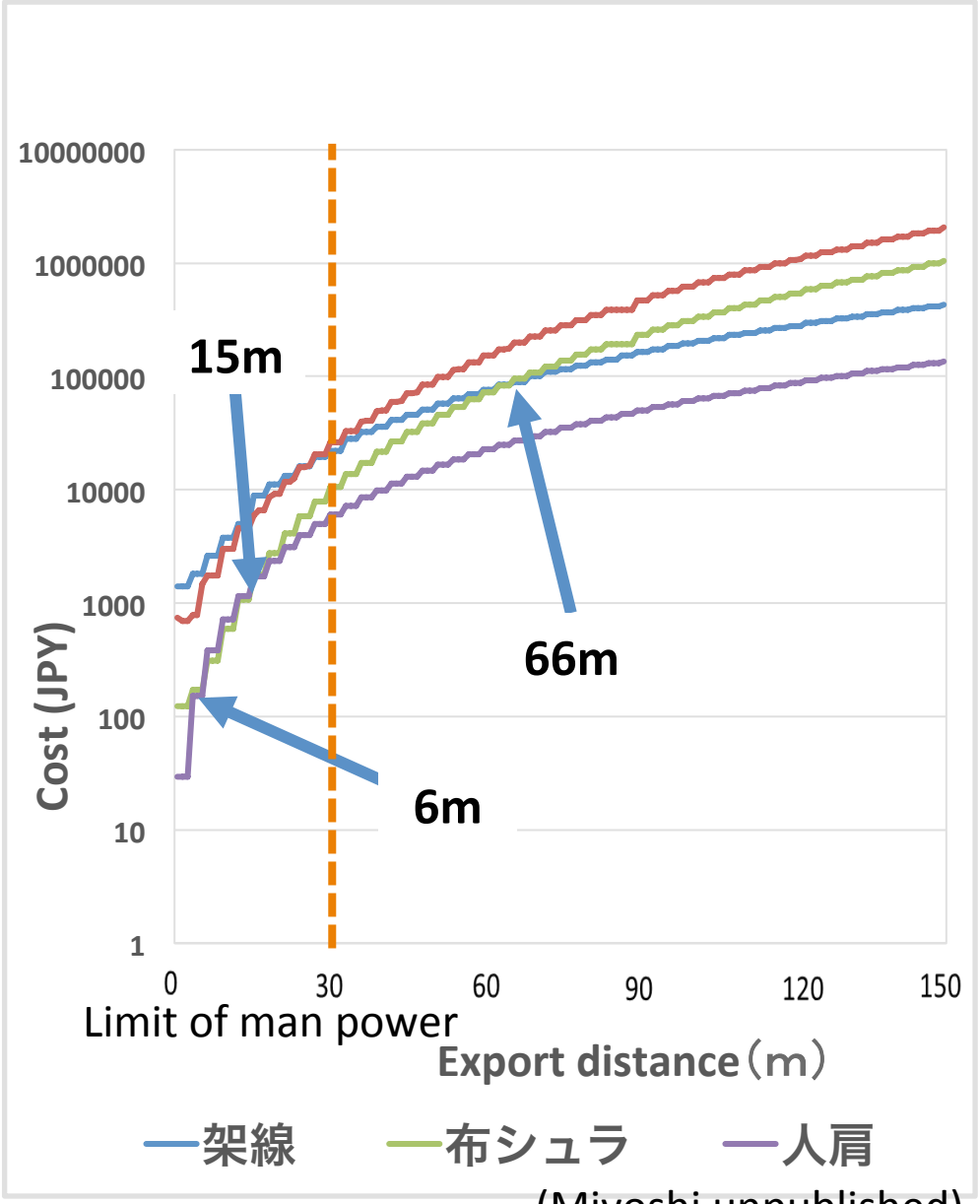
- Results of simulation

Export distance	Method
0m～6m	Man power
6m～15m	Cloth tube
15m～30m	Man power
30m～66m	Cloth tube
66m～	Yarding

Assumption: export in constant pace

Cloth tube is suitable in the distance of 30m～66m

Yarding is better in case of more than 66m



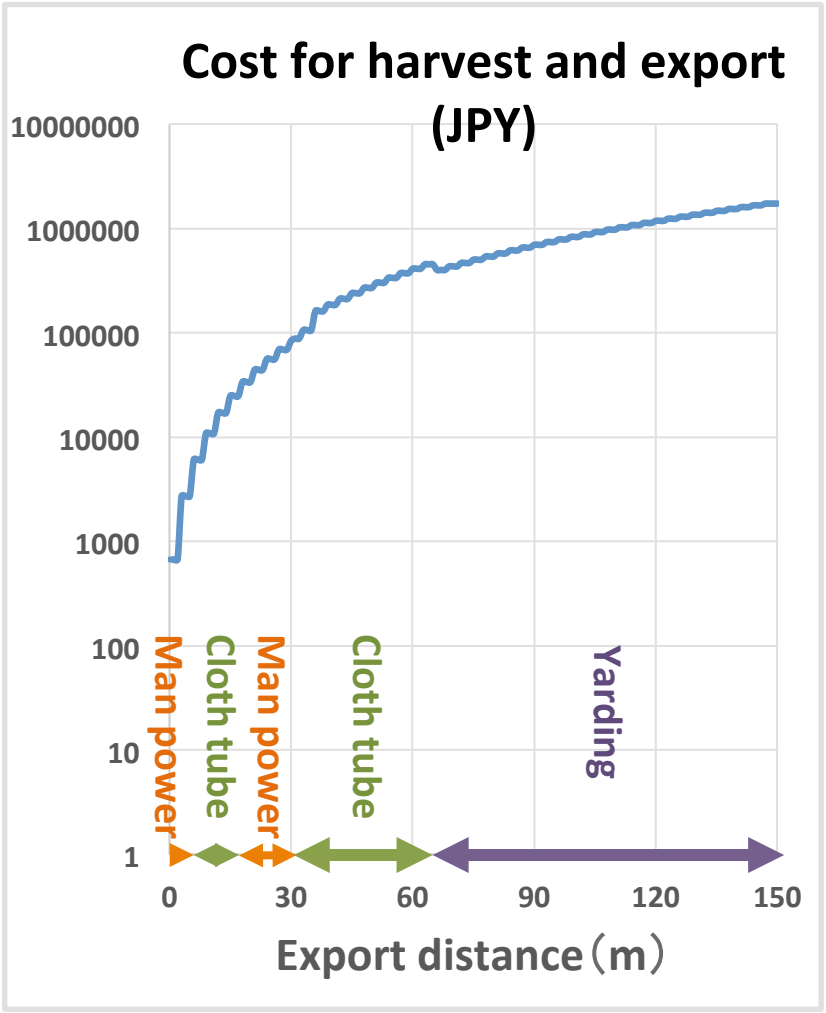
(Miyoshi unpublished)

Optimal harvesting method according to the distance to carry

- Management model

No. of harvest culms: 2500/ha
Cost for harvesting: 91.8JPY/culm

- Results
  - Cost for harvest and export: 229～289JPY/culm
  - Wholesale price: 320JPY/culm (for pulp material)



It was indicated that the determinant of the possibility of bamboo resource use is the **transport cost**.

(Miyoshi unpublished)

Conclusion: Requirement of profitability of farmers

The priority in rebuilding Japan's depressed bamboo industry is to ensure stable farming incomes.

Recognition of farmers' motivation in the management of bamboo forests will result in well-managed forests, favorable environmental conditions and superior biodiversity in the future.

This is one of Japan's most important and urgent tasks today.


THANK YOU FOR YOUR ATTENTION !