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Potential and Needs of Bamboo in Mexico – Considering McClure’s Elite Species and their Applications

Potencialidades y necesidades de los bambúes en México – Comparación con especies Elite de McClure

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Because of its versatility, its wide distribution and its many different species, bamboo has an important future as a sustainable renewable resource. Bamboo has a long history, and projects involving the utilization of bamboo are expanding around the world. More types of bamboo are being brought into cultivation in the effort to improve product lines, increase production volumes to meet industrial needs, and move beyond local & traditional uses.

Floyd Alonzo McClure (1897 – 1970) was an American botanist, employed by the United States Department of Agriculture. Before his role in the USDA, McClure taught horticulture and botany at Lingnan University in Canton (now Guangzhou), China, where he first met bamboo. He became completely enamored with bamboo (like many of us have), and encouraged students in other university departments to join in his investigations of bamboo. Students from the chemistry department and the engineering department researched bamboo products in the 1930’s, while McClure planted out bamboo collections so he could study the useful properties of the species as well as their effects on the soil. From Asia, he assembled over 600 accessions of living bamboo plants



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for observation and study. The United States Department of Agriculture accessioned 250 living plant species selected from this collection during the 16 years from 1924-1940.

In 1941, the Second World War drove Floyd McClure back to the U.S. Under the auspices of the Smithsonian Institution, he continued to research bamboos, and visited almost every Latin American country to study and collect bamboo species. Additionally, he directed programs of investigation, distribution and propagation in several countries, specifically in Puerto Rico and Guatemala. His intent was to make a survey of useful bamboos in the U.S., Mexico, Honduras, Colombia, Venezuela, Brazil and Puerto Rico.

From 1944-1954, McClure served as “Field Service Consultant on Bamboo” with the Office of Foreign Agricultural Service of the USDA, which took him again to six countries in Central and South America, as well as India, East Pakistan (Bangladesh), and the islands of Java and Luzon. Ultimately he was able to establish living collections of what he considered “elite” economic species in Guatemala, El Salvador, Nicaragua, Costa Rica, Ecuador, and Peru. At the same time, he directed propagation studies at the Federal Experiment Station in Mayaguez, Puerto Rico (now known as TARS, Tropical Agricultural Research Station).

In the western hemisphere, the known natural distribution of bamboo extends from 39°25’N in the eastern United States to 45°23’30”S in Chile and even 47°S in Argentina. The distribution bamboo, of course, has been greatly modified by human intervention. Some bamboos have been destroyed by land clearing for agriculture and development (i.e. *Arundinaria gigantea* in the eastern United States, and *Chusquea aculeata* in Central America), and many exotic bamboos have been distributed and naturalized (i.e. *Bambusa vulgaris*, which is now considered a pantropic species).



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Floyd McClure worked hard to identify the distinguishing characteristics and technical properties of several bamboos that he believed showed outstanding potential as economically beneficial plants. Let's look at his recommendations and identify what potentials these bamboos have for commercialization in Mexico. These seven bamboo were selected by McClure because they possess features of scientific interest and industrial promise. Collected and planted out over 60 years ago, few of these have been comprehensively studied. It is vital that more research be initiated if we are to confidently bring these plants into more industrialized markets.

Jones and Wolff state:

“Results will not be quickly or easily attained. None of our present crops, we can be reasonably sure, attained an established niche in agriculture without at least decades of directed endeavor. Many others have failed to attain crop status perhaps more because of a lack of sustained research interest than lack of economic potential in the species involved. A carefully planned program, based from the beginning on the best possible information and with provisions for frequent refinements of evaluations of promising species, as new information is brought to light, offers the best formula for success.”
From “The Search for New Industrial Crops, Economic Botany 14, 56-68, 1960.

McClure goes on to say that regarding the selection of bamboos for individual consideration, no attempt was made to give special emphasis to the needs of the domestic situation in the United States. Actually, of his seven species, only one was considered to be eligible for major attention in the U.S. economy: *Arundinaria amabilis* (now known as *Pseudosasa amabilis*). The aim was “to demonstrate and recommend a rational approach to the selection, out of hundreds of available kinds, of those bamboos that stand out in ways that clearly relate to the needs and conditions of a given economy.” (McClure, 1966) Also interesting to note is that Moso (*Phyllostacys pubescens*) is not on his list of seven elite bamboos. I believe this is because of its difficulty in propagation and its



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cultural requirements to grow well in other-than-perfect conditions. Many may cite the expansive development of the Moso bamboo industry in China, but it is important to realize the resource was already there, as Moso forests have existed and been managed for hundreds of years. It is a model that is not easily replicated elsewhere. Also missing from McClure's list is *Dendrocalamus asper*, which is an incredibly durable bamboo with edible shoots, ability to adapt to many environments, and is widely cultivated.



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McClure's Selected "Elite" Species

Dco dwic'xwi ctlu'

Schrad. ex Wendland

PI #128712 1938 from China via Los Banos

Fgpftqecico wu'ltlkwu'

(Roxb.) Nees

I ki cpwjej iqc'xgtwkwew'r ugwfqctwpflpcegc''

(Willd.) Munro

I wfwc'epi wu'ltlkwu'

Kunth

O gqecppc'dceehgtc''

(Roxb.) Kurz

P.I. #164567 1948 (collected in Jamaica)



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"

Qej wptc'itcxpeqtke"

(Bedd.) ex Gamble

P.I. #198012 1951 (seedlings sent from Almora, India)

Rugwquic'Etwpflpetle'bo cdhku"

Keng (McClure)

P.I. #110509 1936 (collected in Kwangsi, China)

< "P.I." refers to the USDA Plant Introduction number, given at the time recognized importation through the Department of Agriculture protocols. >

It should also be noted that in 1998, the International Network of Bamboo and Rattan (INBAR) published another list, Priority Species of Bamboo and Rattan, (A. N. Rao, V. Ramanatha Rao and J.T. Williams, editors). Their criteria for the selection of species was a bit more outlined, and included the following:

1. Utilization

Relative importance to countries in terms of current use

Relative importance to regions in terms of current use



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Potential importance for expanded use in countries
Potential importance for expanded use in regions

2. Cultivation

Knowledge on degree of domestication and commercialization
Potential for generation of knowledge
Products and processing
Products currently valued
Products likely to increase in value
Enhanced processing shows clear potential

4. Germplasm and genetic resources

Material currently available or expected to be readily available
Degree of genetic erosion of the resource base
Needs for genetic resources conservation programs

5. Agro-ecology

Suitability for agro-ecological zones
Suitability for use in special circumstances e.g. degraded lands, and mountainous areas



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INBAR's twenty priority species are as follows, with 6 of McClure's 7 Elite Species highlighted in **yellow**, or asterisk*. *Rugwif quuc'co cdkku* is not included by INBAR.

Dco dwuc'dcraqc Roxb.

D0'dco dqu (L.) Voss

D0'dnw gcpc J.A. and J.H. Schultes

D0'r qf'o qtrj c Munro

D0'vgz wku McClure

D0'wfc Roxb.

D0'xwi ctku Schrad. ex Wendl*

Egrj cquacej {wo 'rgti tcekq Munro

Fgpft qecrco wu'curgt (Schultes f.) Backer ex Heyne

F0'i ki cpvgu Wallich ex Munro

F0'ic wngt wu Munro

F0'iat kewu (Roxb.) Nees*

I ki cpvqej nq'crwu J.A. and J.H. Schultes

I 0'ngku (Blanco) Merrill

I '0'ugwf qctwfp kpegc (Steud.) Widjaja*

I wcfwc'cpi wakqrkc Kunth*

Ogrqecppc'dceekgtc (Roxb.) Kurz*

Qej rcpftc Thw. (Spp.)*

Rj {nquacej {u'r wdguegpu Mazel ex H. de Leh

Vj {tuquacej {u'ukco gpuku (Kurz) Gamble



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Let's take a closer look at McClure's elite species, alphabetically :

1. *Dco dwuc'kwii ctlu*

(Common Bamboo)

This is a medium-sized bamboo, not densely tufted, with culms 8–20 m tall, bright green, glossy, erect, culm, maturing to a yellowish color. Cultivars with yellow or green stripes, flowering is not common. Internodes up to 45 cm long, 5–10 cm diameter, and thickness of wall ranges 7–15 mm. Branches usually from mid-culm, nodes prominent, lower ones often with a narrow ring of roots, usually covered in brown hairs. Young shoots dark brown to yellowish green. Glabrous leaves 15-25 cm long. Inflorescence is a large leafy compound panicle, with many spikelets. India reported flowering 1851, 1863, 1879, 1890, 1892, 1930. During 1977-1985, sporadic but produced no seeds were reported. Pachymorph rhizomes.



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Vegetative propagation methods: Easy to propagate by culm & branch cuttings, rhizome planting, ground layering, marcotting. Cuttings taken from 1-2 year old culms planted in summer produce good results.

Distribution: *Bambusa vulgaris* is a pan-tropical species. Origin of the species is probably South China, but most commonly cultivated everywhere, especially the horticultural varieties with yellow culms, green culm varieties common in naturalized populations. Three groups are recognized; a) green culm group [*DO'xwi ct ku'xct'xwi ct ku*], b) yellow culm group with stripes— thicker walls than green culms [*DO'xwi ct ku'xct'xk'w'w*], and c) Buddha's belly group [*DO'xwi ct ku'ex'Y co kp*]

Climate and soils: It grows in a wide range of climates and on a range of soils; up to about 1500 m, frost hardy up to -3°C ; plants with green culms are more common, drought resistant, very vigorous on moist soil. Suitable site for this species is moist soil, periphery of cultivated lands, creeks, and at the foot of hills. Shows some salt tolerance. Establishes quickly and assumes luxuriant growth.

Current research: Significant amount of work has been done on various aspects, i.e. harvesting techniques, biology, physio-chemical and medicinal properties etc.

Untapped potential: Adaptation to semi-arid areas, and on degraded and flooded lands.

Conservation status: Not threatened since it is weedy, and easy to propagate by using rhizome, culm branch cutting and layering.



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Uses: It is used for a variety of purposes: building, fencing, scaffolding, furniture, handicrafts, paper and pulp, ornamental, edible shoots of average to poor quality, medicinal value, planted for slopes for soil conservation.

Research needs:

1. Quality and durability need to be improved since it is easily attacked by insects. Preservation techniques are essential to extend longevity.
2. Studies on adaptability, matching the variety with soil type.
3. Studies on variability and germplasm in various countries.
4. Use in degraded areas.

40Fgpftqecrwo wu'ntkewu''

Male bamboo, Solid bamboo

This is a medium-sized bamboo, densely-tufted with culms about 8–20 m tall, internodes 30–45 cm long, thick-walled, 2.5–8 cm diameter, pale blue green when young, dull green or yellow at maturity, much curved above half its height, with thick walls, although slightly 'zig-zag'. Culms are strong; nodes somewhat swollen, basal nodes often rooting, lower nodes often w/ branches, leaf lanceolate 25 x 3 cm. Flowering is considered gregarious (20–45 years cycle), begins w/ intensive, sporadic flowering for 2-3 years, increasing progressively resulting in flowering of all the clumps in a period of 5 years. Inflorescence is a large dense panicle of large globular heads, distinctly apart, hairy; fruit shiny brown, ovoid 7.5 mm long. Management can delay flowering. Pachymorph rhizomes.

Vegetative propagation: culm cutting, offset & rhizome planting, layering, marcotting, macroproliferation of seedlings, in vitro propagation well known.



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Distribution: Native to India, Nepal, Bangladesh, Myanmar and Thailand. Cultivated in many other countries of S E Asia, Australia, USA, Mexico, Central & South America. *Dendrocalamus strictus* is one of the most important bamboos in India. Good reclamation species in ravines. Used extensively as raw material for paper mills, construction, agricultural tools, musical instruments, furniture. Young shoots are edible. Traditional medicinal uses.

Climate and soils: This species is found naturally in pure or mixed forests in semi-arid or dry zones of the plains or hilly areas, very productive up to 150–180 culms/clump. It is drought resistant, however, it adapts well when planted in humid tropical zones and subtropical regions, extends up to 1200 m, grows well on different soils with good water source and drainage, frost resistant, tolerates -5°C up to 45°C . Normally found in drier, open deciduous forests on hill slopes, ravines, and alluvial plains. Prefers well-drained, poor, coarse, grained and stony soils. It occurs naturally in tracts receiving as low as 750mm of rainfall. Grows on practically all types of soil provided there is good drainage. It does not grow in water-logged or heavy soils such as clay or a mixture of clay and lime. Well-drained sandy loam soils are the best for this bamboo. Prefers lower relative humidity. Prefers hilly ground. Resistant to frost and drought.

Current research: Work has been carried out on propagation (seed, vegetative, micro-propagation and mini-clump division); planting techniques, physical and chemical properties, forest management, use in reinforced concrete, suitability for reclamation of degraded lands, grows on variety of soils. Three varieties recognized: – *D. strictus* var. *argentea*, var *proimiana*, var *sericeus*. Some information is available on floral biology and breeding behavior of this species in India. Natural regeneration is good. After gregarious or sporadic flowering, under natural conditions, the seeds germinate soon after the first rains. Felling cycle suggested is 3-5 years. 4 years is preferable since it allows the clumps



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rest and rhizomes are not disturbed too frequently. To avoid congestion of culms, cut in horse-shoe pattern.

Untapped potential: More use is justified in agroforestry and in land reclamation, and use on marginal, infertile soils.

Conservation status: Requires urgent attention, as over-exploitation in native lands is leading to the elimination of varietal germplasm. Varieties in native countries need to be identified and conserved.

Uses: Structural timber, medium to light quality, edible shoots of poor quality (compared to other species.) An important source for paper pulp, average quality furniture, but solid and thick walled, used also for making boards, agricultural implements and household utensils. Leaves are good as forage.

Research needs:

1. Genetic improvement and conservation of germplasm.
2. Genetic diversity evaluation.
3. Taxonomic status of varieties.
4. Development of cultivars.
5. Use on degraded areas.

50I k̄ cpv̄ej̄ n̄c 't̄ ugwf̄ qct̄ w̄pf̄ k̄p̄c̄ egc '''

(syn. *Bambusa pseudoarundinacea*, *B. verticillata*, *Gigantochloa verticillata*, *G. maxima*)
This is a medium-sized bamboo, 7–30 m tall, culms green to yellowish green with thin yellow stripes, aerial roots on lower nodes, with internodes 35–45 cm, diameter 5–13 cm, medium to thick wall, 2cm thick and is very strong.



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Leaf blade 20-25 x 2.5-5 cm; inflorescence is a large leafy panicle with spicate branchlets with heads of spikelets, and spikelets also appear on nodes, fruits narrow, linear, minutely pubescent, tipped with persistent style.

Reported flowering in 1854 and 1982. Pachymorph rhizomes.

Vegetative propagation: culm cuttings, branch cuttings, rhizomes cuttings, seeds.

Distribution: Origin not known, said to be native of Java, found in cultivation in Sumatra and Java, introduced to India, and Peninsula Malaya, China, Southeast Asia, Australia, USA, Mexico, Central and South America.

Climate and soils: Mainly grows in humid tropics but it can also grow in dry areas and up to 1200 m above sea level, sandy loam and alluvial soils, tolerates -2°C .

Current research: Work is underway to evaluate its suitability for bamboo board, and other construction manufacturing.

Untapped potential: Its value as processed building material should be explored.

Conservation status: Requires attention. There are some germplasm collections in Bogor, Java and Lampung, Sumatra, Indonesia. Natural hybrids in Sumatra have been observed to produce seeds.

Uses: Widely used as poles and also used for roofing and walls, structural timber, building materials, medium quality, used as water pipes; for making handicrafts, furniture of very good quality, household articles, musical instruments, basketry, chopsticks, toothpicks, edible shoots of very good quality (especially preferred in Java).



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Research needs:

1. Suitability in agroforestry
2. Floral biology and induction of seeding
3. Basic properties (physical, chemical, mechanical)
4. Provenance trials

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60I wcfwc 'ēpi wāhāqīk"

Guadua

This is a large, spectacular, sympodial bamboo with culms reaching 30 m, dark green color, with white bands at nodes. Diameter up to 20 cm; leaves medium size. It is considered outstanding in stature, with superior mechanical properties and durability of culms. Guadua plays an important role in rural economies for building construction. Very open, expansive pachymorph rhizomes.

Distribution: Origin South America, well distributed and cultivated in Central and South America. Introduced to many other countries around the world.

Climate and soils: Grows on rich to medium soils, especially along rivers and on hilly ground, tolerates -2°C . Grows at sea-level to 1,700m, with temperatures ranging between 20-26°C, and an average annual rainfall from 130cm to 254cm, relative humidity of 80%. *I Ōcpi wāhāqīk* prefers loose, fertile, well-drained soil with a thick layer of humus.

Current research: Present research efforts includes studies on culm preservation techniques and determination of the physical properties, includes strength testing and new product development.



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Untapped potential: Valuable on sloping lands, and for soil conservation. New product development necessary for expansion into industrial markets.

Conservation status: Unknown.

Uses: Structural bamboo, large, strong, superior quality, it is a multipurpose bamboo. Though most extensively used as building material for low-cost housing or even for big buildings, it has many other uses in rural communities and is used for general-purpose furniture making, handicrafts. Most popular bamboo in Central American countries; houses and large buildings built of this bamboo have withstood the shocks of earthquakes, and related factors. Commercial plantations are increasing.

Research needs:

1. Survey of patterns of variation in natural populations and to generate more information on conservation status.
2. Sustainable management of natural stands.
3. Provenance trials.
4. Propagation technology
5. Use of young shoots.

700 graqppc 'dceehgtc (syn. *Bambusa baccifera*)

Muli Bamboo

This is a medium-sized bamboo, 10–20 m tall, clump open and diffuse. Culms have relatively thin walls 0.5–1.2 cm, internode 20–50 cm long, diameter 3–7 cm, culm tips pendulous. Culms green when young, straw when old.

Leaf blade lanceolate, 14–28 x 3–5 cm; inflorescence 15–45 cm long, compound panicle drooping, spikelets 1–1.5 cm long, stamens three, anthers yellow, elongated style with



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2–4 lobes; fruits large 7.5 – 12.5 cm long, 5–7.5 cm broad, beak curved with thick fleshy pericarp; flowering cycle reports vary, from 30–35, 45–48 and 60–65 years, both sporadic and gregarious flowering. Culms and rhizomes die after flowering. Profuse natural regeneration. Fruits fleshy, viviparous, germinate easily producing seedlings. Very open, expansive pachymorph rhizomes.

Vegetative propagation: Culm cutting, rhizome cutting, seedlings.

Distribution: The species naturally grows throughout the hill forests of Bangladesh, Myanmar and North East (Assam, Arunachal, Meghalaya and eastern part of Tripura, Nagaland, Manipur, Mizoram) of India. The natural home of this bamboo is believed to be Chittagong Hill Tracts where this species grows gregariously, covering large tracts of land. It is also cultivated in south-eastern Terai part of Nepal and southern border of Bhutan, probably introduced from Bangladesh; occasionally cultivated or introduced and planted in many botanical and private gardens all over the world, including, Hong Kong, Indonesia, Taiwan and South America.

Climate and soils: The species very adaptable; it can grow on highly weathered deep clay soil to shallow to very deep loamy soils, well-watered sandy clay loam, alluvial soil and on well-drained soils consisting of almost pure sand even at the summits of low sandstone hills, with pH 4.5–6.0 and rainfall 300–500 cm, with temperature range of 5–37°C. Melocanna occurs as an undergrowth to many tree species and also forms a diffused clump in a pure stand by aggressive nature of its underground rhizome in areas after burning. It shows wide adaptability as a good colonizer on lands cleared of forests. Easy to propagate, grows quickly. Rhizome development starts within 40 days after germination. Easy to regenerate from rhizomes.

Current research: Grows well under different conditions, has great potential,



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more research is needed.

Conservation status: Conservation work needed. In its native ranges, the local ethnic people have been conserving the bamboo only in the settled forest areas. The species is still wild and not yet well domesticated.

Uses: Culms are naturally durable with inconspicuous nodes, much used for roofing, thatching, matting and in house construction, therefore there is great demand in cottage industries, pulp and paper and rayon mills. Used to make rafts for transporting other timber logs. Fruits are edible. Young shoots are edible. All the ethnic people of Chittagong Hill Tracts use it as a tasty vegetable (shoots or seeds) and also sell in the market, leaves used for preparing liquor.

It is reported that in *M. baccifera*, two types of clumps exist in nature, judged on the basis of emerging shoot characters. In one type, shoots possess a yellowish culm sheath and are usually preferred as edible shoots. In the other, the sheaths are comparatively deep brown and not usually favored as food due to their bitter and astringency taste. Selection of cultivars is needed.

Research needs:

1. Exploration and identification of different flowering populations existing in native regions and the fruit types.
2. Identification of diversities and their conservation.
3. Selection and multiplication of elite types.
4. Identification of out-of-phase flowering “types” and their characterization.
5. Scientific management of vast areas of *Melocanna* forests for sustainable use.
6. Role in soil conservation on the hill slopes along with water resources management in the catchment areas.
7. Use on degraded areas.



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Comments from Ximena Londoño on this species in Colombia:

“It is medium-size bamboo with strong culms, good for basketry and handicrafts. It grows fast and can be managed like *Guadua angustifolia* because it does not grow like the clumping Asiatic tropical bamboos. It is well adapted to the Colombian weather of the Coffee region.”

80Qej wpf t c 't c x c p e q t k e c "

Elephant grass

Qej wpf t c 't c x c p e q t k e c is a clump-forming, perennial bamboo with short rhizomes, producing erect culms 2-6 m long, grayish-green, rough. The woody culms are reed-like, 2.5-5cm in diameter, the internodes terete (cylindrical or slightly tapering, and without substantial furrows or ridges), thin-walled, 45-60cm long, sometimes 1.5m long, the culm-nodes swollen. Flowering is gregarious and sporadic. Inflorescence is a long spicate panicle, stamens many, free filaments, ovary with long style, stigma 4–6, fruit large, ovoid, with long beak, pericarp thick fleshy. 4-5cm long. Flowering cycle is probably about 15 years. Natural regeneration occurs from seeds and rhizomes. After germination, seedlings take 6-8 years to develop into full clumps.

Pachymorph rhizomes.

Vegetative propagation: Culm cutting, rhizome offsets, seed. Seed is best sown as soon as they are ripe. They are sown in nursery beds filled with sand and soil mixture in partial shade initially for two months. Seedlings can be transplanted into their permanent positions after a period of one year. Rhizomes can be separated from the culms during the onset of the monsoon and used for field planting. Two-noded culm cuttings of two-year



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old plants treated with NAA or coumarin by cavity method and planted horizontally in nursery beds during summer gives 50 per cent rooting. After one year, the rooted cuttings can be transplanted to the field. During field planting, many plantlets are obtained from the rooted cuttings by separating the sprouts along with the rhizome. Seedling plants take 6-8 years to develop into full clumps, which then can last for a period of 25 years

Distribution: Western Ghats of South India and in the southwest region of Sri Lanka, up to 1500 m, grows well with heavy rainfall. It grows wild and is cultivated as an undergrowth plant in the low-level evergreen and semi-evergreen forests. Pure patches grow as impenetrable thickets are also found along the sides of rivers and streams. This species prefers diffused light, requires a rainfall of more than 150cm and requires good drainage for proper growth. Grows best in sandy loam with granular structure, high porosity and good aggregate stability and with high water holding capacity. This species is very efficient for soil conservation.

Climate and soils: Species belonging to Ochlandra mostly occur in rich loamy soils especially along perennial or semi perennial streams, on sloping lands. Often growing close to rivers, the plant can survive seasonal flooding and strong currents. The plant is often grown along paddy fields, where it acts as a soil binder. The soil under this species in general is dark brown, acidic, sandy loam with granular structure, high porosity, good aggregate stability and with high water holding capacity.

Uses: Ideal raw material (long fibers) for paper manufacturing. The shoots, when 6 to 9 months old, constitute a splendid paper material. The fiber has been compared superior to esparto (a coarse grass from North Africa and Spain used to make rope, wickerwork and paper). Culms are used for mat and basket making, umbrella handles, fishing rods, handicraft, and locally used for making walls of huts and household items. Leaves used for thatching. Mats are made into bamboo ply.



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Current research: Some work is in progress on seed storage and silvicultural management of this species. Intensity of flowering, seed characteristics, moisture content, seed longevity have been worked out.

To effectively manage the existing resource, the following management strategies are recommended: a selective felling system with a feeling cycle of 4 years, comprised of a) culms less than 2 years old should not be cut, b) all the new culms and 25% of the old culms should be retained, c) no clump should be clear-felled before seeding, d) culms should be cut at one internode above ground, e) cutting should be done without disturbing the new emerging culms. (Kumar 1990)

Also note, natural preservation and durability is enhanced by soaking the reeds (culms) under running water, or 2% boric acid so finished products have glossy greenish appearance.

Untapped potential: This is an excellent species for binding soil which can be used to reclaim degraded land and for soil conservation. Research is needed in value-added product development and its potential as biofuel biomass.

Conservation status: Conservation programs have not yet been organized as over-extraction continues in its native range.

Research needs:

1. Genetic improvement, superior plants.
2. Testing of physical and mechanical properties.
3. Matching the species and varieties to specific soil conditions.
4. Tissue culture protocols for propagation and plant improvement.



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”

90Rugwf quic 'to cdhlu (syn. *Arundinaria amabilis*)

Tonkin Cane, Tea Stick Bamboo

The following characteristics are responsible for this bamboo's "elite" status: the culms are naturally straight, very slightly tapered, stiff and resilient. It lacks prominence of nodes, has high density, toughness, and has very strong wood. Culms are distant in a grove, strictly erect, straight or nearly so; branches typically three at each mid-culm node (sometimes only one), slender, stiff, the central one dominant. Branches are lacking in the lower half to two-thirds height of mature culms. Leaf blades are dark green above, paler (glaucous) below; oblong-lanceolate. Under plantation management, the grove is open and culms reach 12m in height and a diameter that may exceed 5cm.

Flowering is cyclic and gregarious within a given population of plants with a common origin. Length of flowering cycle is unrecorded, except by McClure. He observed a 10-year flowering period (1929-1939) in Guangzhou, China. Its termination was accompanied by gradual recovery of vegetative vigor. Rhizomes remained viable. Fruit production was rare. Leptomorph (running) rhizomes.

Propagation: Clump division, rhizome cuttings.

Distribution: Tonkin cane is only known in cultivation, with the central area of commercial production being in Guangxi region of China. This region borders Vietnam



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province of Tonkin, which is probably the origin of the name Tonkin Cane, suggesting the primordial origin of the species.

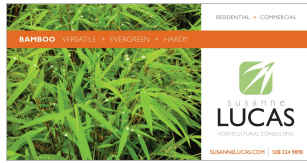
Climate and soils: Since this plant is only known in cultivation, reports of where it grows best is our only guide. However, Guangxi has a subtropical climate. Summers are generally long and hot. Average annual temperature is 17 to 23°C, while average annual precipitation is 125 to 175 cm. Tonkin cane prefers a cool tropical region, with well-draining, organic soils. Minimum temperature is probably about -9°C, and it prefers full sun. It grows best at higher elevations that receive abundant precipitation. Established plantings can be found in Savannah, Georgia USA and Avery Island, Louisiana USA. McClure established plantings of this species in Guangzhou, China, Mayaguez, Puerto Rico (but they have subsequently died), as well as San Andres, El Salvador and St. Augustine, Trinidad.

Uses: Poles, especially for agriculture. Ski poles, pole-vaulting, walking sticks. Fishing poles, especially high-quality fly rods. Decorative wood trim. Arrows.

Current research: None, to the best of my knowledge.

Untapped potential: In Mexico, this species could only thrive in cooler regions with high precipitation at higher elevations. It is a cool-tropical species.

I think there is a lot to learn from the comments here below, coming from Floyd McClure decades ago. His words still hold a great deal of validity today, as we consider more



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expansive agro-forestry in bamboo as an alternative fiber and sustainable building material. I have italicized words to emphasize his points.

<<Vj g'ewnkxc vkqp'qhldco dqq'ku'erqugrf 't grcvgf 'vq'vj g'pggf u'qhl'vj g'rcpf 00Oriental bamboo growers claim that the technical properties and lasting qualities of a given bamboo are generally superior when the plants are grown on soil of somewhat inferior fertility. They counsel *ci chpu'igt vkkl kpi* a bamboo plant that is grown for its culms alone. From this it is to be inferred that *kv'o c' 'dg'wpf guk'cdng. 'cu'y gni'cu'geqpqo kecni' 'wpuqwpf. 'vq'vwkk'g' 'vj g'o qu'igt vkkg'ci t kwwmt cr'rcpf u'igt 'vj g'ewnkxc vkqp'qhldco dqqu'igt 'vko dgt 'r tqf wewkqp.*

In the cultivation of tropical bamboos for the production of edible shoots, *hkcdkkl'v* of the soil is of greater importance than *igt vkkl'v*. The annual operations of clump renovation and subsequent hilling up of the earth around the base of the clump to etiolate the shoots are performed with greater ease and effectiveness if the soil is not too heavy. The applications of prescribed soil amendments at the right times and in the right amounts to get maximum yield and quality is elsewhere considered a sound and economical practice. But it must be tested afresh under each new or distinct combination of ecological, economic and human factors.

The chances for improving land-use patterns, and local opportunities for utilizing bamboo, will vary from area to area. *Xgt' 'kwng'j cu'dggp'y t kwgp'cdqww'vj g'r qvqpw'krkkgu' qhldco dqq'cu'c' 'wcdkkl'gt 'qhl'uqkl'c'pf 'eqpvt qmgt 'qhl't wpqhlh* from the angle of soil and water conservation or watershed stabilization. The dense shade cast by the plants keeps competition from weedy growth to a minimum. The abundant annual leaf-falls develop a deep mulch under the plants. This conserves moisture, contributes to the development of favorable conditions for the building of good soil, and promotes normal development of the plant. Furthermore, the culms may be harvested without seriously disturbing the



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mulch or the soil. *Khpqy "qhlpq"qvj gt "v\rg"qhl'rwpv'i tqy vj "vj cv'ecp" {kgif "cp"cppwcn'letqr "*
cpf "cv'vj g'uco g'vko g'ugt xg'cu'cp"ghgexkg" {gct/tqwpf "rqi /vgt o "rtqvexqt "qhl'y cvgtuj gf u0

Considering bamboo as it relates to the needs of the people, it will be useful to study the exploitation of bamboos from two distinct angles: that of present and potential uses in the immediate community, and that of export possibilities. *Wugu'ko r qt wpv'kp "qpg'ewmw'cn'qt "*
geqpqo ke'ugw'kpi 'o ki j v'dg'xkgy gf 'y kj "pq'o qt g'vj cp'ewt kquk' "d{ "r gt uqpu'ht qo "cpqvj gt "
o kkgw Objects that have no use, application or value in the place where they are fabricated may bring a substantial price if exported to another area where either the bamboos are lacking or the essential skills have not been acquired, or labor costs are too high. >>

[From Unasyuva: Bamboo culture in the South Pacific by F.A. McClure, Section of Plant Introduction, United States Department of Agriculture]

To conclude, let's think about what bamboos can bring to a local region in a broad sense. Let's compare climate maps and soil maps to see which species will thrive where, and consider why this region should consider bamboo. Perhaps using criteria such as those listed under INBAR's priority species selection, keep in mind which species is most suitable? Is the ecosystem degraded, does the watershed need protecting? Is there demand for a new crop? Is there sufficient capital to provide appropriate preservation techniques and manufacturing equipment? What products are needed locally? Is there a potential for export? Is there a local population needing work? Who will "work" the bamboo farm? Will the farm benefit the community at large? Is there sufficient infrastructure to move the product to the people who want it, i.e. roads, distribution centers, etc? Where and who is the competition? Is there the possibility for cooperative systems, i.e. harvesting, preservation, transportation?



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Floyd McClure realized the potential of bamboo as a “new crop” over 60 years ago. And recently, planting bamboo has been addressed in Paris at COP21 as a tool for mitigating climate change. If this plant has the ability to be a global tool, it certainly has merits as a plantation crop in Mexico. Bamboo can improve the environment in practical ways (soil stabilization, watershed management, soil remediation) and it can act as a bio-filter, providing purification of soils, water and air. At the same time, bamboo can improve the welfare of a local population by providing it with income. Bamboo provides livelihoods via the cultivation and production of goods. No other plant has the ability to interrelate ecological, social and industrial functions, including the purification of the soil, water and air, the creation of a green economy via the localization of renewable products, alternative fiber and the establishment of a secure sustainable energy source. The future of bamboo in Mexico looks certainly positive, and with more concentrated research on specific species and adaptability, bamboo can become a priority for ecological remediation, business investment and economic progress.



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