POSTERS

The Philippine Bamboo Industry: Recent Updates

R. T. Aggangan and R. J. Cabangon

Abstract

Bamboo is one of the most important non-wood forest products in the Philippines. It has been used for the manufacture of different products used for construction, furniture, handicrafts and chemical products. . It was however in 2010 that the Philippine bamboo industry was formalized by virtue of Executive Order 879 that stated that the Philippine bamboo industry development be made a priority program of the government and created the Philippine Bamboo Industry Development Council (PBIDC) to provide the over-all policy and program directions of the program for all stakeholders. At present, the most extensive use of bamboo is for the manufacture of engineered bamboo for school desks for all public schools as mandated by EO 879. Also, engineered bamboo products are used for high-end construction and furniture as well as for handicrafts. In addition, processing wastes from bamboo are recycled into fuel products such as charcoal and pyroligneous liquor and used in soil remediation as well as industrial deodorizers.

This paper outlines the present status of the bamboo industry in the Philippines, including demand and supply, technological achievements and policy formulations/implementation to invigorate the local bamboo industry.

Keywords: *engineered bamboo, furniture and handicraft, housing and construction; chemical products, policy*

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Nombre del Tema: e.g 1.1. Arquitectura e Ingeniería

EXPERIENCIA COMO DESPACHO DE ARQUITECTURA Y NUESTROS PROYECTOS EN BAMBÚ

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Abstract (300 words max)

Somos un despacho de arquitectura joven con énfasis en el diseño de calidad y enfoque sustentable a sus proyectos. Nos gustaría aprovechar este espacio para compartir nuestra experiencia como diseñadores. Nos aventuramos al bambú, esta andanza nos ha llevado a conocerlo. Aprendimos del Arquitecto Raúl De Villafranca, nuestro primer maestro en el proyecto para Uumbal. Con él comenzamos a entender sobre conexiones, proveedores, el manejo del bambú. Construimos 20 edificios, 5 prototipos. Nuestro segundo maestro y mentor es Jörg Stamm. Con su asesoría dimos un gran salto. Con estos proyectos para Uumbal fuimos reconocidos con Mención Honorifica en la XIV Bienal Nacional e Internacional de Arquitectura Mexicana. Es mucho el esfuerzo y camino que se tiene que recorrer para usar el bambú; habiendo tantas opciones de materiales accesibles en el mercado, al bambú le falta dar el paso para prosperar. Gracias a nuestro compromiso con una visión sustentable y las condiciones propicias para desarrollar este conocimiento hubiéramos claudicado. El uso del bambú se queda en aquellos pocos que tienen los conocimientos que celosamente guardan como secretos. Aprovechando este foro nos gustaría exponerles la importancia de que juntos nos sumemos a lograr este brinco que tiene que dar el bambú para estar a la altura de materiales accesibles, se tiene que compartir la información, capacitar entre todos al gremio de la construcción, y generar juntos esta cadena de valor donde todos prosperaremos.
El mundo busca opciones sustentables y es la oportunidad de que el bambú brille.
Accesibilidad- Que los proveedores la lleven a tiendas.
Conocimiento- Divulgar esta información.
Construcción- Personas capacitadas que lo sepan construir.
Crear ejemplos que inspiren… Les compartimos los proyectos que hemos diseñado con la intención de inspirarlos: La Ceiba, Bambú Techos, Crece tu Casa, Casa Valle.

Palabras Clave: Bambú, Jörg Stamm, experiencia, cadena de valor, accesibilidad, conocimiento, construcción, inspiración.

Wooden Architecture | Environment | Morphology

Designed by Gods for Wooden Architecture of TreGaard

by Thomas Allocca (Italy)

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Abstract: In its frentic search of new materials and technical solutions to drastically reduce carbon dioxide emissions of the building processes, the world of sustainable architecture is turning-on always more spotlights on bamboo as source of timber recognizing wooden architecture as the most potential sustainable one and the main road to run toward the challenge of the global warming. In this context, as a designer and journalist expert in wooden architecture, I have focused my researches on timber bamboos on the species Phyllostachys Bambusoides, and this paper illustrates my point of view and my last discovery about its morphology reporting a sacred proportion for a highly symbolic architecture not only using it as objective high-quality timber.

* * * *

Thanks to trees and their timber we have been capable to evolve from Homo Erectus to Homo Sapiens till to become Homo Architectus, what we need now is to reach the next evolutive step becoming Homo Arboreous passing from being designers and buildiers of wooden architecture as "made from forests" to design and build arboreal architecture as "made for forests". Homo Arboreous is the father of my ideal city TreGaard, the arboreal conception of the architecture as a tree-centric building phylosophy based on the motto "from woods architecture was born, to woods architecture must return". It is in this context that high-quality timber bamboo forests can help wooden architecture to evolve to the higher level as "tree-centric" and not simply made of wood, with trees, forests, Gaia at the same time issue and aim of every single project, from a simple wooden table to a whole city. TreGaard's architects are planners of forests before than planners of buildings, they design architecture not just as an instrument to inhabit the world with the illusion to impose human supremacy through blatant arrogant buildings just symbols of stupidity, but architecture as supreme instrument to live forests, as living whispered poetry in tight relationship with natural capitals and genius loci. TreGaard is the low-carbon city for excellence where every single building produces more carbon credits than carbon emissions. Small or huge, poor or rich, every single building of TreGaard is a temple, the best place where every deity feels at home. TreGaard is the summa of the

tree-centric building phylosophy where simple is not poor but synonym of essential richness to make humble and more useful the complex, where minimalism doesn't mean poor in details but sublime sense of synthesis, where no one detail is never casual or lacking of history for how much it can appear as marginal or unessential. My researches on timber bamboos for sustainable architecture want to be my humble but passionate contribute to the still sleeping or disoriented academic world looking for solutions to make architecture as much sustainable as profictable, and my scream to the blatant architects just authors of wooden speculations rather than noble architecture where every single piece of wood is a new step toward TreGaard.

It is in the context of my specific researches on the timber bamboo species Phyllostachys Bambusoides that I have reported the following data and considerations.

Geometry defines the "segment" as a precise alignement of infinite points, and if we consider every single point as a possible solution to divide the segment in two parts, we can say that a segment can be divided in two parts in infinite ways. Among these infinite solutions, one is the point that divides the segment in two equal parts, all the other solutions which are infinite are always two disequal parts. Using mathematical terms, if we have a segment X different from zero, we have infinite solutions can verify the equation $X=X_1+X_2$ with $X_1=X_2$ or $X_1<X_2$ or $X_2<X_1$. Among these infinite solutions some of them are really special because particularly useful to define mathematical concepts and solutions. For example, if we have $X=X_1+X_2$ with $X_1=X_2$ we are defining the center point of the segment X, i.e. the point x belonging both to the half segment X_1 and to the half segment X_2, in other words every point y of the segment X and different from x will define $X_1<X_2$ or $X_2<X_1$ dividing X in two disequal parts, but it also means that if we want to find the exact middle point of a segment we can simply verify if its value verifies the equation $X=X_1+X_2$ with $X_1=X_2$.

Another interesting solution is $X=X_1+X_2$ with $X_1=X$ or $X_2=X$ defining the concept of zero, i.e. if a segment is the summa of two parts and one of them is the whole segment, the other part will be zero (X+0=X and X-0=X), a banal consideration but really important in mathematic to define the concept of neutral quantity and to make possible to complete the operation "-" with all real numbers (R) and not only possible when "x-y means x>y". Zero is also important to define the concept of infinite, for example if a segment X can be divided in two parts X=X+0 it means we can repeat this operation infinite times never changing the result: X = (X+0)+0 = ((X+0)+0)+0 = (((X+0)+0)+0)+0 and so on infinite times, always having the result = X.

Among the most fashinating solutions of possible divisions in two parts a segment X, the point x that divides it in $X_1+X_2=X$ with $X_1<X_2$ and $X_1=0.382X$ and $X_2=0.618X$, defines the proportion

$X_1:X_2=X_2:X$ better known as Golden Proportion or Aurea Proportion or Gods Proportion. This particular ratio has been used since ancient times in architecture, in music, in painting and in every art based on mathematical proportions, and thanks to electronic calculators and computer graphic simulation it has been discovered in recent times that this ratio defines the base-geometry of some of the most complex and perfect elements of Nature, from stars to plants to animals.

As a designer I am daily used to work with numbers and geometries and my designs are based as much as I can on Golden Proportion to make symbolic references to universal harmonies. But my interest for Golden Proportion comes also from the scientific knowledge that our brain appreceates this proportion, among rectangular shapes, as the best one, and it happens inconsciously also without having a specialized mathematical knowledge. I have personally made an experiment about this issue showing to different clients the prototypes of a wall wooden lamp I have designed in four solutions, squared, rectangular in proportion X by 1.618X (golden proportion), rectangular in proportion X by 1.5X, rectangular in proportion X by 2X, and everytime the choice was on the square or on the golden proportion, and they didn't know the minimal mathematical difference between the three rectangular solutions.

Well, so used to work with these numbers and geometries it was easy to me to recognize in Phyllostachys Bambusoides something familiar. I have analyzed the ratio between culm diameter (D) and culm height (H) both using data from scientific literature and using data directly from my plants or from plants of friends, and both the results have been amazing. Considering an average maximum size of the culms at best soil and climate conditions, i.e. about 16 cm in diameter and 26 m in height, we have H:D = 2600:16 = 162.50, which means H = 162.50D. Almost the same with smaller culms till to 4 cm in diameter and reporting results always closer to the proportion H:D = 161.25 i.e. H = 161.25D. At this point I have analized the average proportion considering the maximum value 162.50 and the minimum value 161.25 to better identify the real average proportion considering culms of every size starting from 4 cm in diameter which is the minimal size I consider for this bamboo as useful to timber applications. The result has been incredibly amazing because making the mathematical average (162.50+161.25):2 we have 161.875 i.e. $H = 1.61875(10)^2D$. Interpreting these numbers in terms of Golden Proportion we can say that culms height and diameter of Phyllostachys Bambusoides are defined by an extraordinarily precise ratio based on a multiple in scale-up $(10)^2$ of the Golden Proportion, one of the most perfect geometries found in Nature, as to tell us that this bamboo has been designed directly by gods to make of it, more than every other timber bamboo, the most suitable source of timber for high-quality wooden architecture but also rich in symbolic meanings deserving a primary role in sustainable wooden architecture toward my ideal arboreal city of TreGaard.

Bamboo in traditional and cultural practices of Manipur, India

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Abstract

Manipur nestled in the North eastern part of India has the highest bamboo acreage, diversity and stock and is aptly called as "Bamboo paradise of the country". With about 3,268 square km of area covered by bamboo forests, Manipur is one of India's largest bamboo producing states and a major contributor to the country's bamboo industry. Bamboo in this region is very deeply interwoven with day to day life of the people and given outmost importance being used in many religious and social rituals, for construction of houses, making household items and weapons, food, medicine, entertainment etc. People of the region have also developed various techniques and technologies for using bamboo in their day to day life. Meetei people of Manipur consider it lucky to have a bamboo grove in the courtyard. Similarly many tribes of the region consider bamboo as deity and use it for many ceremonies and rituals. It is found to be used inumerable ways to create a large variety of articles which are more or less used in day to day lives. Bamboos are used from a simple thin split for tying to the construction of the whole house bamboos. Ethnic articles like *yangkok, phoura, meruk, polang, hangen, poura, longup, ngarubak* and *mora* are some examples which are used in almost every house. Young shoots are a delicacy of the region and it is only in North east India where bamboo shoots are fermented for food and consumed round the year in various forms. The shoots are now being recognized as a health food as they are not only nutritious but have many health promoting phytochemicals. It is only in North-East India where bamboo shoots are fermented for food and consumed round the year in various forms. Regions like Kwatha have developed their own unique techniques of bamboo fermentation for making fermented products such as *soijin, soidon* and *soibum*.

Though with urbanisation and modernization, the use of this "green gold" has reduced and shifted towards other materials like plastics and steel but the local people still use bamboo for many household purposes and are still the lifeline and source of income of rural people. Manipur has still kept alive the bamboo heritage and culture by organising cultural festivals like *Sangai festival* which showcase bamboo crafts and products. Various tourist spots are also decorated with indigenous bamboo items. Nowadays, creativity in the form of local product development and traditional art has become a major force in the global economic turnaround and bamboo has a great potential for Manipur as well as the Indian subcontinent.

Capacity Building of Rurals of Mountainous Regions on Multiplication, Conservation and Value addition of Ringal (Hill bamboos) in Uttarakhand state of India

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Abstract

Mountainous regions of Uttarakhand state in India are encrusted with four hill bamboo species viz. *Sinarundinaria anceps, Sinarundinaria falcata, Thamnocalamus falconeri* and *Thamnocalamus spathiflorus* collectively known as Ringal which are residing at altitudes ranging from 1200-3000m. The culms/clump of Ringal have been conventionally used for making goods to provide livelihood support to a large number of families. They also contribute significant role in soil conservation and recharge ground water by their intricately worn rhizome system.

Over usage of this resource coupled with many biotic and abiotic factors, has tremendously reduced this species in nature, consequently affecting livelihood of many villagers. It was thus felt imperative to conduct surveys and analyze socio-economics of the villagers in relation to Ringal. The surveys indicated that over the years, the thickets of Ringal has been reduced to barren lands causing acute scarcity. The impact was more pronounced on old artisans who have the skills of making goods but sitting idle due to lack of this vocation. The young generation has left for white collar jobs in nearby towns. To improve the situation, it was necessary to conduct education and awareness programme in Ringal rich mountainous regions of Uttarakhand.

FRI took initiative and conducted many trainings involving traditional artisans, women, Panchayats and Forest departments in harvesting, conservation, replanting and sustainable production of Ringal for long term utilization and economic generation. School children who are mainly engaged in cattle rearing activity in these regions were also involved in this Education and Awareness programme. Skill development and value addition of the products via these trainings showed impact. The expected enhancement in economic returns of villagers through these trainings is presented in this paper.

Conservation Strategies of Hill bamboos (Ringal) to Sustain Rural Economy in Garhwal Himalayas in India.

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Abstract

Due to ruthless deforestation, forestry has become critical to sustain ecological and economic security of many developing countries including India. In Garhwal Himalayas, per capita land availability for crop cultivation is very scarce and just sufficient for their survival, hence cannot be diverted for other nonwood forest products, so the villagers are dependent on forests for extraction of nonwood forest products for their sustenance. Ringal (hill bamboos) is one of the important nonwood forest produce in this region which has paved livelihood support to many artisans of the area in terms of Basketry and handicrafts. The species has constantly being removed from forests without replanting efforts, diminishing regeneration and causing acute shortages to villagers. There is constant threat of gene erosion and the very existence of the species. No proper attention has been paved for management and conservation of this crucial species.

Forest Research Institute has taken innovative steps to build up genetic diversity of Ringal and established a Germplasm at Pauri (1954amsl) comprising of four hill bamboos represented in the state. The Germplasm has nearly 300 accessions of *Sinarundinaria anceps, Sinarundinaria falcata, Thamnocalamus falconeri* and *Thamnocalamus spathiflorus* collected from diverse wild locations of its occurrence all over India. The Germplasm is being used by many Rresearchers and Scholars for various studies pertaining to evaluation, conservation and utilization of Ringal Resources.

For *In situ* conservation, we developed an innovative technique which is described in detail and forms the context matter of this paper. The villagers, Panchayats, Forest departments, School children and Eco task force are being apprised with this conservation technique which is simple, farmer friendly and cost effective. *In situ* conservation in forests itself would not only ameliorate economic status of rurals through sustainable production but would also generate sufficient material of Ringal for future generations.

INDUSTRIALIZED-HANDICRAFT IN COMMUNITY BAMBOO ENTERPRISE DEVELOPMENT

By CARMELITA B. BERSALONA

(ABSTRACT)

Industrialized-Handicraft is a strategy that takes a community from where they are to where they want to go using bamboo , a material that is indigenous in their community and part of their culture or way of life as their vehicle for sustainable bamboo enterprise development (e.g. Oxytenanthera abyssinica into square bamboo panel or Schizostachyum lumampao into plyboo). Because they know the material and its uses (product), the community can be helped with an introduction of new designs or technology can be developed or adopted based on what they need or what most people need especially products that are required in volume and with continuity. In the process, the community innovate age old processes at the pace of their ability to design, fabricate or re-engineer their own tools, jigs and machinery, unafraid to explore and make mistakes.

Through Industrialized Handicraft, each member of the community begins to know costs and systems, understand and manage – product, process, people and profit . Each member begins to see the "whole" and the "parts". Moreover, the community is empowered and is able to acquire the tools and develop/put together skills they need to actualize an enterprise producing a marketable product which in the beginning be an institutionalized marketable product (e.g. school furniture) to ensure continuous production to build up needed capital. These are further actualized through the In-Hand Productivity Formula.

In_Hand Productivity Formula

Labor & Material – 40 %
Administration – 5 %
Overhead – 10 %
Tools & Jigs – 5 %
Research & Development – 5 %

Marketing – 5 %
Cost of Money – 2 %
Intracapital – 10 %
Profit – 18 %
(labor – 6 %, capital - 6 %, Management -6 %)

TOTAL 100 %

Through industrialized-handicraft, a community bamboo enterprise is developed. The bamboo that has been taken for granted by people as it has grown wildly in the mountainsides is now cared of as plantations, farm-to-market roads are constructed, other infrastructure needs like electricity and materials such as adhesives are developed as well. Correct harvesting and curing procedures are instituted and the whole culm receives a commercial value. As the bamboo takes new forms to benefit more people, more research and technology development are done.

In the process of development in the countryside, man and material develop simultaneously benefitting each other. In Africa, particularly in Ethiopia, Ghana, Tanzania and in Asia like the Philippines and India, through the International Network for Bamboo and Rattan with the support of other organizations like CIDA and IFAD, community bamboo enterprises owned and managed by the people have been established and are on the road for expansion and replication.

Bambú en Chile. Su transformación en el tiempo

En Chile, hace unos años atrás siempre aparecía la misma discusión.
´Es colihue o bambú´?
Hoy es más fácil reconocer el colihue como una de las especies nativas de Chile.

Ahora comienza el interés y valor por un material, siempre conocido pero mal visto.
Hoy se le está dando una nueva mirada y un nuevo reconocimiento.

El colihue, está demostrando a través de algunos ejercicios de Arquitectura y Diseño, que es resistente, firme, buen aislante, sus propiedad de flexibilidad en un territorio sísmico como el nuestro es un gran beneficio y aporte a mejorar la calidad de vida y resolver problemáticas con este material de poco uso y de abundancia en nuestro país.

La aparición de este material que siempre a estado presente en nuestra cultura Mapuche, y que hoy solo se vuelve a mirar. A dado un salto y reconocimiento en su uso.
Creando nuevas posibilidades y nuevos desafíos, a los que nosotras como emprendedoras queremos abordar.

Queremos compartir la experiencia de esta transformación y como a través de nuestros trabajos hemos ido visibilizando este material, abundante, generoso, esbelto, estéticamente atractivo. Que nos permite crear y desarrollar soluciones para nuestro entorno.

Bamboo in Chile. Its transformation over time

In Chile, a few years ago, it was always the same discussion. Is it colihue or bamboo?
Today it is easier to recognize the colihue as one of the native species of Chile.
Now the properties of this material, always known but frowned upon, are being recognised for the first time.

Today it has a new look and a new acknowledgement.
It has now been shown that colihue, through some examples in Architecture and Design, is a resistant, firm and good insulator, and is also flexible at the same time.
These qualities have great benefits and contribute to improving the quality of life aswell as solving problems with this material of little use and abundance in our country.

The appearance of this material, has always been present in our Mapuche culture, and today has beeen rediscovered and recognised for its uses. Creating new possibilities and new challenges, which we as entrepreneurs want to address.
We want to share the experience of this transformation and how through our work we have made this material, abundant, generous, slender, aesthetically attractive, visible.

Maira Bisquett Chang /. www.bamboobiz.cl / Chile

DESIGN AND DEVELOPMENT OF A DIY BAMBOO SHELTER

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ABSTRACT

This project developed and showcased a "Do-It-Yourself" Bamboo Shelter using modular construction system. Panelized forms of walls and roofs using bamboo poles from bolo (*Gigantochloa levis*) and coconut lumber as columns and frames were used since they are readily available in most parts of the Philippines. A user's manual on the "step-by-step" procedure in assembling and disassembling the Shelter was prepared. The actual cost of the full-size DIY Bamboo Shelter was also determined.

The 24-sq.m. (6m x 4m) DIY bamboo shelter was erected at the province of Leyte, Philippines. The concrete flooring was first constructed with anchor bars erected at the corners of the floor. This anchor bars were used to anchor the rectangular timber posts at the corners of the shelter. Once the posts were erected, the modular walls were connected to the posts followed by the modular truss and roofing systems.

The complete package of the DIY Bamboo Shelter include: a living room, kitchen, bedroom, toilet and bath and sink. Its modular components can fit in a 6-wheeler truck and can be assembled and disassembled within 3 – 4 days by 4 medium-built workers. It is environment-friendly wherein 90% of materials come from renewable resources. The shelter is electricity and water supply – ready and is cost-effective. It can be used as temporary or semi-permanent shelters in calamity-stricken areas, emergency shelters, as well as cabanas in recreational resorts. The Shelter has six variants that cost around USD 1,500.00 (shell only without concrete slab) to about USD 3,000.00 (complete).

The concept of the DIY bamboo shelter is that it comes in as a kit upon purchase that contains a simple manual on how to construct the house, thus, using only simple tools. This is an innovation made for such a time when climate change and natural disasters, and economic problems like the increasing cost of building shelters and limited supply of raw materials are affecting the lives of most developing countries.

***Key words**: bamboo panels, modular, emergency, temporary, semi-permanent shelter*

Topic: Society (Teaching and Dissemination)

Phyllostachys *aurea* from decorative to structural

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Abstract:
In Ecuador, 44 species of bamboo are registered, only two (giant bamboos) of which are used as structural components in buildings. The Phyllostachys *aurea* due to its thin physiognomy, has been destined to work only in furniture and decorative elements.
This work of research focuses on the application of this specie to architectural elements, using the construction of Grid shells, prototype-sized, thus providing experimentation opportunities that can lead to innovative solutions regarding the use of this material.

Grid shells are lightweight structures that attract large quantities of clear-span without the need of having central elements, making them very efficient structures in the architecture-wise, however they are really complicated to handle during the construction process. The real challenge of this research regards the use of this species of bamboo, in its natural state (cylindrical cane), which complicates the construction process of those type of structures even more. To this end, practical workshops have been created, where students and locals all work on the construction of these structures.

Will be presented in this work: the comparative analysis of the behavior of the grid shells structures with Phyllostachys *aurea* and other bamboo species such as Dendrocalamus *asper* and Guadua *angustifolia* (behavior of the structural members included in the connexions used in those structures and the rotations of the culms once the net transforms their plane shape into the curved aspect of the grid shells). It has also been proved that thanks to the participative construction experience, the constructive innovation integrated in these kind of constructions represents a great opportunity to end the prejudices and reinvent the idea people have of this type of material.

Keywords: Phyllostachys *aurea*, bamboo, grid shells, Connections, Participative construction.

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NOMBRE DEL TEMA: AMBIENTE

PROPUESTA DE MANEJO PARA BANCO GERMOPLASMA DE BAMBÚ EN GRAN PARQUE METROPOLITANO DE LA HABANA, CUBA

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Resumen

Bambusa vulgaris Schrader ex Wendland se encuentra mayormente distribuida en todo el país, fundamentalmente en orillas de los ríos, en forma de plantones. La misma es protectora de agua y suelos, tiene gran uso ambiental entre otros. Este trabajo se ejecutó en la condición ecológica del Banco Germoplasma de bambú cercana al río Almendares ubicado en la localidad Husillo, pertenecientes al Gran Parque Metropolitano de La Habana. Con el objetivo de definir la propuesta metodológica para el manejo sostenible de la especie. Para ello se tuvo en cuenta los estudios realizados de autoecología de la especie. Aspectos relacionados con su estado de conservación, evaluaciones en el área, los resultados del inventario forestal realizado en las plantaciones, la tecnología para el manejo sostenible de la especie, así como la definición de los criterios e indicadores para el manejo sostenible a nivel de especie con objetivo protector y además las metas que se quieren alcanzar en el lugar de estudio. Se obtuvo la propuesta metodológica para el manejo sostenible de *Bambusa vulgaris*, el cual consta de cinco etapas.

Palabras clave: inventario forestal, manejo, propuesta metodológica

NOMBRE DEL TEMA: AMBIENTE

RELACIONES HÍDRICAS DE *BAMBUSA VULGARIS* SCHRADER EX WENDLAND EN PLANTACIONES EN LA PROVINCIA DE PINAR DEL RÍO, CUBA

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Resumen

De las especies de bambú, B*ambusa vulgaris* Schrader ex Wendland es la especie mayormente distribuida a lo largo de toda Cuba, fundamentalmente en orillas de los ríos, en forma de plantones. La misma es conservadora de los suelos, tiene gran uso en la alimentación, construcciones entre otros. Con el objetivo de caracterizar su relaciones hídricas se realizó un estudio en diferentes condiciones ecológicas a lo largo del río Cuyagüateje para plantaciones de la especie. Se evaluaron tres sitios: Consejo Popular los Portales, Consejo Popular Punta de la Sierra y Asentamiento Humano Rural Concentrado la Güira, pertenecientes al municipio Guane, provincia Pinar del Río. Para ello se tomaron medidas de intercambio gaseoso, potencial hídrico y transpiración. Los resultados indican que los potenciales hídricos reflejan diferencias entre épocas estacionales, obteniéndose valores menos negativos en el sitio Asentamiento Humano Rural Concentrado La Güira, donde la especie se desarrolla sobre suelos arcillosos facilitando mayor retención de humedad, siendo además el de mayores tasas de transpiración.

Palabras clave: intercambio gaseoso, potencial hídrico, transpiración

NOMBRE DEL TEMA: AMBIENTE

ESTADO DE PROTECCIÓN DEL BAMBÚ EN DOS SITIOS DEL GRAN PARQUE METROPOLITANO DE LA HABANA, CUBA

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Resumen

Bambusa vulgaris Schrader ex Wendland especie de gran importancia para la localidad por sus usos en la protección en la orilla de los ríos y reguladora de la erosión del suelo. El trabajo se ejecutó en dos áreas de la faja forestal hidrorreguladora del Arroyo Santoyo, Bosque de Pogolotti y Finca de Adalberto Morejón, pertenecientes al Gran Parque Metropolitano de La Habana. Con el objetivo de conocer el estado de protección del bambú se evaluaron los plantones desde el año 2005- 2017. Para caracterizar la dinámica forestal de la especie se tomó información de los registros del equipo técnico del centro en estudio en el período referido anteriormente. Se utiliza metodología para los criterios de evaluación del estado actual de conservación de los culmos que incluye grado antropogénico, estructura de la vegetación, presencia de talas, presencia de la regeneración natural, estado sanitario, categorías de amenaza y los niveles de seguridad. La distribución de las parcelas se realizó mediante el método de muestreo aleatorio simple. Además la herramienta utilizada fue un cuestionario de tipo grupal para la recopilación de las causas del deterioro de las plantaciones protectoras. Los resultados en dichas áreas arrojaron una valoración de regular, se comprobó la estructura regular y malas prácticas de manejo en los plantones lo que causa el principal deterioro de la especie: “Malas prácticas de manejo”, con una alta ponderación.

Palabras clave: deterioro, causas, manejo

SISTEMAS ESTRUCTURALES PREFABRICADOS CON BAMBÚ. UNA ALTERNATIVA SUSTENTABLE Y SEGURA PARA LA RECONSTRUCCIÓN

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Resumen

Un desastre natural resulta de la combinación de la ocurrencia de fenómenos naturales peligrosos y determinadas condiciones socioeconómicas y físicas que hacen vulnerables los ambientes humanos. Durante el mes de septiembre del año 2017, dos sismos de gran magnitud (8.2 y 7.1 en la escala de Richter) golpearon a México causando daños a edificaciones, con más de 150 000 viviendas afectadas en todo el país, con pérdidas materiales estimadas en 2 mil 500 millones de dólares. En la Ciudad de México, aproximadamente 7 000 edificaciones presentaron daños en distintas magnitudes, muchos de ellos concentrados en zonas de alta marginación en el Sur de la Ciudad. La colonia San Gregorio Atlapulco, ubicada en la delegación Xochimilco, fue afectada de manera importante con casi 1 000 viviendas afectadas.
Distintas agrupaciones sociales de carácter independiente, actuaron de manera inmediata para apoyar a los cientos de familias afectadas. Uno de los casos de reconstrucción han sido liderados por miembros de la comunidad alemana en México, y las empresas Kaltia y Bambuterra, con el fin de apoyar a cuatro familias de escasos recursos, cuyas viviendas se perdieron durante el sismo. Considerando los diversos y complejos factores de la zona, se propuso una solución de vivienda progresiva, que implementa un sistema prefabricado a base de componentes estructurales de bambú (Sistema BiBa®), que se apoya sobre una losa de cimentación de concreto armado, cubriendo un área aproximada de construcción de 155m^2. En este trabajo pretende compartir la experiencia de construcción social usando bambú, y la estrategia para su replicabilidad en otros casos de reconstrucción para la misma zona.

Palabras claves: Bambú, Reconstrucción, Sismo, Prefabricado

Name of the Theme: e.g. 1.1. Taxonomy & Morphology

Case study of bamboo building concepts in the Chapala Riviera, State of Jalisco, Mexico.

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Abstract
Two building cases where executed by two multidisciplinary teams working in site to transfer bamboo-building technology in context of rigid building practices. These two multidisciplinary teams consisted of civil engineers and architects students involved in social housing and small building projects of persons in need. In parallel, these students were working in developing technology for rapid and secure joint assembly. The issue address by these bamboo joint proposals where fragility of culm failure. One of these bamboo proposals was built on site and the other won a national bamboo house competition.

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Keywords: Bamboo, plastic reinforced joint; community intervention

Application of hyperboloid geometry in bamboo structures for the project CAJamilli (Casa Artesana Jamiltepec, Oaxaca, México)

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Abstract
Santiago Jamiltepec is located at the southwest coast of the state of Oaxaca, Mexico. Its principal income, tourism generated by the visits of family to detainees in the local penitentiary, was lost when it closed. The lack of employment has increased delinquency while the jail is closed suffering from decay.
A group from the Taller Max Cetto, from the Universidad Nacional Autónoma de México, developed an investigation about infrastructure and requirements from Santiago Jamiltepec with the purpose of designing an Art Center that benefits the population. This Art Center would be placed in the old jail.
Local music, textiles, and construction have ancient roots in the village, so we decided to create an Art Center using them as guidelines. Therefore, the center would contain classrooms and a stage. In it, music and dance will transform this gray jail into a colorful music box.
The construction of the stage is based on typical constructions. At "Costa Chica", bamboo is used as a building material when it is mixed with mud. The result is called Bahareque. We took bamboo and developed three kiosks.
These kiosks are designed as a hyperboloid because of its structural qualities. Its form and symmetry give resistance against earthquakes and hurricanes. This is important because the project is located within an earthquake area and very near to the sea, so the weather is very hot and rainy.
These three kiosks seem like three clusters that will provide a shadow to practice typical crafts. It is an open space that can be used as a stage or workshop. In its inner hollow part, there would be a cinema cabin. The cinema screen would be placed over the monumental yard walls.

The project is currently looking for sponsors to make a real music box for Oaxaca's coast.

Construcción de prototipo Warka Water en la Universidad Marista Tlahuac, CDMX

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Resumen

El agua se puede cosechar y así dar solución al problema del acceso al agua potable. El arquitecto italiano, Arturo Vitori, diseñó una torre fabricada de bambú, con una red de un polímetro biodegradable que capta el agua de lluvia y de neblina.

Este proyecto surge a partir de tradiciones y elementos naturales como el árbol Warka, un árbol sagrado bajo el cual se reúne la sociedad a tratar temas de la comunidad. Los primeros prototipos de *Warka Wate*r fueron instalados en Etiopía; y se han construido más de 5 prototipos para probar distintas geometrías posibles.

Se construirá en el primer semestre del 2018 un prototipo de torre de cosecha de agua *(Warka Water*) en la Universidad Marista (UMA) con el objetivo de sentar precedente para construcción de *"Warkas"* que atiendan la falta de agua potable en las colonias cercanas que resultaron más afectadas por el sismo del 19 de septiembre del 2017.

El drenaje de las colonias está en estado marginal, varias grietas se abrieron en las colonias Nopalera, la Turba, el Molino y la Colonia del Mar, aledañas a la Universidad.

Se elije la construcción de este proyecto por la viabilidad de construir estructuras con curvas parabólicas o hiperbólicas con bambú. Dicha geometría es posible por las características físicas del material, que aporta rigidez lineal y un grado de flexibilidad justo. Cabe aclarar que las geometrías a las que se aplica se pueden desarrollar como superficies curvas formadas por segmentos rectos.

Con este proyecto se pretende aplicar lo aprendido en las clases de geometría además de dar soluciones a problemas sociales con materiales tradicionales y no agresivos con el ambiente.

Palabras Clave: Construcción, geometría, potabilización, condensación, tecnología.

(Theme: 1. Environment; 1.2 Commercial plantation and management; Plantation planning and Management & Harvesting)

Productivity studies in a *Bambusa balcooa* monoclonal plantation.

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Bambusa balcooa is an introduced & widely planted bamboo species in farmlands of Tamil Nadu in South India. A six year old *Bambusa balcooa* plantation, with an espacement of 5 x 5 meter, raised in North eastern agro-climatic zone of Tamil Nadu was harvested completely with retention of only 4 culms of recent origin. Data on number of culms per clump and individual culm dimensions viz., culm diameter, culm wall thickness, culm weight and culm height were documented during harvest. Five clumps per replication were studied and 10 replications were randomly laid, across *B. balcooa* plantation spread over 3.93 ha. area, to have a fair sample of the standing biomass. In all, culm dimensions of 990 culms, harvested from 50 sample clumps, were documented. The number of culms per clump averaged at 20 while the average culm diameter was 50.38 mm. Average wall thickness of culms harvested was 21.80 mm. Height of the individual culms averaged at 13.23 feet and the average weight of the freshly felled culms was 6.42 kg. Total yield from the 3.93 ha. plantation was 212 tonnes. Paper discusses data collected from sample plot vis-à-vis total harvest obtained from monoclonal plantation and possibility of using data collected from sample plots to predict final yield of farmland raised monoclonal bamboo plantations.

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(Theme: 2. Society; 2.1 Community and Economic Development; Social, political and economic inclusion)

Socio-economic profile of farmers growing bamboo in farmlands of Tamil Nadu, India.

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Tamil Nadu, located in Southern part of India, is not a bamboo resource rich state of India. Farmers cultivating paddy in the rice bowl of Tanjore Delta in Eastern Tamil Nadu, traditionally, grow a few clumps of *Bambusa bambos* on elevated bunds or lands adjacent to paddy fields to meet their fencing requirements. With concept of tree cultivation outside forests gathering momentum in Tamil Nadu, and Government of India's mission mode schemes to promote bamboo cultivation in farmlands, bamboo is being cultivated at espacement ranging from 5 X 5 meter (400 clumps/ha.) to 3 X 1.2 meter (2777 clumps /ha.). Contact details of bamboo growing farmers was collected from agencies involved in promoting bamboo cultivation outside forests viz., Tamil Nadu Forest Department, Tamil Nadu Horticulture Department, Tree growers association etc. Survey was conducted by visiting 149 bamboo growing farmers from 21 districts of Tamil Nadu and their socio-economic profile documented to understand reasons for taking up bamboo cultivation in their farmlands, problems faced by them and prospects facing them. Intensity of silviculture techniques adapted in bamboo plantation raised in farmlands varied from rain fed to drip irrigated. Non-native bamboo species, viz., *Bambusa vulgaris* & *B. balcooa* were preferred bamboo species of farmers for cultivation in farmlands over native bamboo species viz., *Bambusa bambos* and *Dendrocalamus strictus*. Most of land holdings under bamboo cultivation were less than 2 ha. Decentralized nature of these farms was found to discourage potential bulk bamboo consumers-pulpwood industry-to offer buy back agreement to bamboo, unlike pulpwood species. Lack of marketing opportunity, along with lack of awareness on bamboo biology and avenues for value addition in bamboo is found to affect sustainability of bamboo cultivation in Tamil Nadu. Lessons learnt from these surveys had helped to identify bottlenecks hindering sustainability of bamboo cultivation in farmlands of Tamil Nadu and to take up proactive marketing initiatives, such as creation of a 'Bamboo Market Information Centre' along with "Bamboo Help Line" and conduct of "Bamboo Growers & Entrepreneurs Meet" to provide much needed marketing linkages between bamboo growers and industries.

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1.3 Ecology and Environmental Concerns.

LIFE OF CYCLE ASSESSMENT OF A HOUSING SOLUTION BASED ON BAMBOO PREFABRICATED CONSTRUCTION SYSTEMS

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Abstract
Nowadays, the construction practice is a complex activity that involves different kinds of environmental impacts categories: climate change, toxicity, acidification, abiotic depletion, eutrophication, Ozone layer depletion, etc. The companies Kaltia Consultoría y Proyectos S.A. de C.V. and Bambuterra S.A.P.I. de C.V. are developing a bamboo construction system called BiBa®. The BiBa® system is composed by a prefabricated system for shear-wall (Biopanel) and a prefabricated system for slabs and roofs (Bambulosa®) with bamboo and other materials. The objective of this study is to determinate the environmental performance of a house built with BiBa® system and finally compare it with a conventional concrete house with similar construction area.
This study presents the life of cycle assessment of a house built with BiBa® system and evaluates its environmental impacts under the requirements of the standard NMX-SAA-14040-IMNC. Environmental impacts were analyzed in 4 phases: primal materials, construction, use and final disposal.
Keywords: Bamboo, Environmental impacts, Prefabricated systems, Life of cycle assessment

Disposable bamboo - *Guadua angustifolia* kunth, sustainable alternative for the present and future of our planet

Arq. Ivan Gómez Garcia
Lic. Florencia Eduardina Speck Garzón
Esp. Paula Viviana Hincapié Correa

Abstract
Plastic is one of the elements that is most used in the for its usefulness in daily life; exemplified from a bag up in aircraft fuselages.
However, despite its usefulness, the great problem lies in that it is too polluting because it is obtained based on petrochemicals (plastics, icopor, Iusacell, among others); evidence in the millions of disposables we use daily; affecting the water sources, rivers, seas and the ecosystem in general; at the level of living beings (humans, animals and plants) that in contact with food and drinks; It generates poisoning slowly and gradually.
Research worldwide shows that these take between 500 and 1000 years to decompose. In Colombia, whose leadership in the legislation regarding the use of plastic, law 163, 4143, seeks to eliminate both the bags that we use for almost everything from bread to household appliances, until the total elimination of it.
Particularly in the region of the Coffee Axis Colombia, a group of researchers have been given the task of making disposables based on bamboo - guadua angustifolia kunth, managing to pulverize the bamboo, obtaining a natural plastic paste; experience for more than twenty years.
The process consists in the selection of the material, preservation with the Modified Boucherie system applied to the bamboos with steam pentaborate, broken, peeled in an industrial lathe to obtain fibers that are then transferred to a crusher, turning them into powder, with a chemical process (100 % natural) we obtain a homogeneous, flexible, plasticized and moldable paste, that in press and crushed according to molds and with natural glue (casein, cassava starch and others); resulting in a product that is resistant, and according to use and needs, the disposables required by the market are obtained; thus contributing with a natural process, obtaining disposable biodegradable and sustainable, friendly with the environment.

Ceramic bamboo - *Guadua angustifolia* kunth

Ivan Gomez Garcia
Paula Viviana Hincapie belt
Florence Edwardian Speck Garzón

Abstract
At the start of the fascinating world of bamboo, became us question the materialization of all sorts of objects based on this material. As we move forward in our research we are materializing more that increasingly concern. Therefore, the breakdown of the fibers of the bamboo - guadua (Angustifolia Kunth), we will increasingly achieving results that our eyes are amazing. We've been consolidating one one our goals. One of them comes from the crazy idea of manufacturing ceramic bamboo - guadua (Angustifolia kunth). We started a process of investigation of the development of ceramic as such; We find that it is a material that is available everywhere in the world, but depending on your origin as well is the result of product colour, texture and others. Our country of origin does not have a strong management of ceramics: decorative, utilitarian and other increasingly rely on our friendly country China for the supply of such objects. It is for this reason and due to the large number of natural acres to Colombia and especially the coffee area; planted in bamboo - guadua (Angustifolia kunth), the idea to materialize the ceramic needs our country, which not only would generateemployment; If not that also could diversify greatly the variety of objects in all its manifestations.

Preservación y Secado de los bambúes con el Sistema boucherie modificado aplicado con vapor.

Iván Gómez García

Abstract

Los Bambúes son el oro verde del siglo XXI son un recurso prodigioso, existente en la mayoría de los países del mundo, en América los tenemos desde Estados unidos hasta la Patagonia.
Sus Propiedades Físico, Químico Mecánicas, son Excepcionales, su crecimiento vertiginoso; y sus más de 2000 usos, los hacen uno de los materiales más "versátiles, prodigioso, desafiantes, creativos, fascinantes, fantásticos, armonioso, y asombroso del planeta.
Los Bambúes por ser un material orgánico son susceptibles de ser atacados por Insectos y Hongos. Más de 30 especies de insectos y 10 variedades de microorganismos.
Investigaciones recientes han despertado mucho el interés en encontrar Sistemas de Preservación y Secado Eficientes y Confiables.
Se han utilizado, sistemas, métodos, preservantes de todo tipo, algunos con muy buenos resultados, pero en la gran mayoría de los casos con muchos inconvenientes y fracasos.
La preservación y el secado son uno de los inconvenientes que más problemas presentan los bambúes, muchas veces hasta ni se usa ningún sistema, o preservante, complicando aún más la calidad, durabilidad y resistencia de los bambúes.
Es por esto que presentamos el sistema de preservacion y secado con el sistema boucherie modificado aplicado con vapor, para lograr una buena preservacion y secado como lo es aprovechando las caracteristicas intrinsicas de los bambues ,aplicando la ley 1 de la termodinamica.: Cuando un sistema se pone en contacto con otro más frio o caliente que él, tiene lugar un proceso de igualación de temperatura de ambos, generando una presión y un trabajo mecánico.

Bambú Chiapas, nace en 2009 a través del proyecto "Aprovechamiento del bambú como motor de desarrollo económico sostenible y fuente de conservación ambiental para comunidades indígenas de la Cuenca del Usumacinta, Chiapas, México financiado por XANVIL A.C. y Fundación Interamericana. Durante este tiempo nos capacitamos en áreas clave como administración y capacitación técnica y silvícola en el uso y manejo de tres especies de bambú: *Guadua aculeata, Guadua angustifolia y Bambusa oldhamii.*

En 2011 nos constituimos legalmente como una Asociación de productores de bambú del Usumacinta S. A de C.V. de R .L. Diseñamos y promovimos una guía rápida tipo comic, "EL BAMBÚ (Resistencia, belleza y utilidad)" buscando sensibilizar a productores en la cultura del bambú en el Estado de Chiapas. En 2012 nos dimos a la tarea de buscar alianzas de desarrollo comercial estratégicas para reforzar a la región como punto prioritario de producción de bambú en México, dando como resultado en 2013, el Centro de Trasformación del Bambú, en la ciudad de Palenque, Chiapas, con apoyo de la Fundación Produce A.C. Parte de nuestra colaboración se definió en la capacitación para el manejo de viveros y preservación del bambú. En 2014 impartimos talleres en Oaxaca y Chiapas con diversas temáticas cómo Cambio climático, producción de bambú con perspectiva de género y técnicas para la propagación y manejo de viveros.

Iniciamos el 2015 capacitándonos en la manufactura con técnicas para las uniones de bambú con resinas epoxicas y fibra de bambú; propuesta que se realiza de manera artesanal y con la construcción de nuestra propias herramientas. Ese año obtuvimos un **prototipo** de **bicicleta** de ruta elaborada con un **cuadro** de **bambú** ("**Proyecto "Selvática**"), dando como resultado un producto sólido, resistente y competitivo, con el plus de su manufactura sustentable. Este prototipo y la experiencia del proyecto es la base para desarrollar en el corto plazo (2018) nuestro Espacio de aprendizaje y aprovechamiento de materias primas en Palenque, Chiapas.

¿Quiénes somos?

Somos la unión de un equipo de **emprendedores** que tenemos como **misión** vincular e impulsar la articulación de iniciativas sostenibles productivas, sociales, ambientales de alto impacto que colaboran en los sectores primarios y secundarios, que promuevan una sociedad resiliente, a través de la trasferencia del conocimiento, experiencias, tácticas y servicios de desarrollo sustentable.

El **objetivo es la trasferencia de conocimientos y saberes culturales tradicionales y científicos,** fomentado un equipo de trabajo multidisciplinario, enriquecido con la ideología de transformar y empoderar proyectos productivos innovadores sobresalientes de alto impacto social y ecológico; Además de incentivar **nuevas propuestas** para nuestro entorno.

A continuación un listado de temáticas que el proyecto ofrece a manera de colaboración, intercambio y/o enlace con otros proyectos.

1. Planes de manejo para plantaciones forestales comerciales.
2. Propuesta de Manejo de cuencas hidrológicas en diferentes ecosistemas.
3. Modelos de conservación de suelo y agua
4. Transformación de materias orgánicas
5. **Técnicas de bioconstrucción con Bambués y otros recursos naturales**
6. Modelo piloto de creación de banco comunitario como proyecto productivo
7. Curso de establecimiento y manejo eficiente de plantaciones de bambú
8. Taller elaboración de medicinas tradicional y herbolaria.
9. Manejo de viveros forestales, huertos semilleros y bancos de germoplasma
10. Huertos orgánicos y transferencia de eco-tecnología
11. Taller de capacitación de preservación del bambú
12. Cosecha y pos cosecha importancia y valor agregado del bambú
13. Curso prevención y control de incendios forestales
14. Curso de Organización y Gestión Empresarial
15. Taller de Empoderamiento y Organización social
16. Talleres de Joyería y artesanía con materia prima
17. Alianzas para una red de comercio justo de productos orgánico

Atentamente.
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Bamboo Boat: an experimental project for an eco-sailing practice

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Abstract
Today, sailing is evolving greatly thanks to funboard democratization and the constant search of high performance. *Bamboo Boat* is a design project to build a flying dinghy with a tubular structure made of bamboo. It offers a direct response to environmental issues raised by sailing practices - in terms of material production and treatment of boat wastes. *Bamboo Boat* as it is today is an ideal ground for innovation and development in the field of bio-composite. This paper aims to explore in what extend bamboo, as bio composite material, can make emerge new issues about sportive naval construction?

Fortalecimiento de la cadena productiva de bambúes para la generación de nuevas industrias sostenibles en America Latina

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[g]Organización Mundial del Bambú – WBO

Abstract
En un mercado globalizado de elevada competición, donde los productos acabados de origen sostenible vienen ocupando un mayor espacio, los sectores agrícola y forestal se ven obligados a trabajar de forma más eficiente, con especies bien domesticadas y tecnificadas en todo su proceso productivo; todo esto, evitando agredir el medio ambiente. En América Latina, las condiciones edafoclimaticas, diversidad biológica, localización, disponibilidad de tierras para implantar grandes proyectos forestales, hacen de ella, una región capaz de producir productos de origen forestal con elevado valor agregado. Los bambúes se destacan por su abundancia en la región Amazónica, en países como, Bolivia, Brasil, Colombia y Perú. En el mundo ocupan una cobertura vegetal estimada en 37 millones de hectáreas (algo superior a 4% de la cobertura vegetal). En Asia son utilizados para la alimentación, construcción, producción de biomasa, carbón activado, alcohol, celulosa y papel, fibras textiles, bebidas, entre otros. No por nada, conocida como la planta de mil y una utilidades. Actualmente, la China tiene 5,7 millones de hectáreas de bosques de bambúes (18% del mundo) y es el principal productor mundial de productos a base de bambú, con un comercio mundial de 19,5 billones de dólares por año. En América Latina, los bambúes ocupan un área de 10,3 millones de hectáreas. El Brasil tiene 9,3 millones de hectáreas de bambúes y no realiza exportaciones significativas. Lo mismo ocurre en Colombia, donde existen aproximadamente 50 mil hectáreas. El género *Guadua* se destaca en América Latina y el mas expresivo es el *Guadua angustifolia* Kunth; nativo de Colombia y muy explorado tradicionalmente en la construcción y las artesanías. De forma general, e pese a sus grandes áreas de ocurrencia natural, los bambúes nativos en América Latina no son adecuadamente aprovechados. Esto queda claro con las irrisorias exportaciones realizadas en relación a las exportaciones mundiales de Asia. Y esto se debe a la inexistencia de una metodología de exploración eficaz, una estructura adecuada que garanta el suministro de forma económica, segura y constante para una empresa. Así como, el desconocimiento de los

principales productos demandados en el mercado internacional, ya sea en el presente o su demanda futura. Otro factor que afecta, son las leyes ambientales inherentes a cada región. Debido a que los bosques de bambúes naturales se encuentran predominantemente en áreas de protección ambiental, presentan leyes (restricciones) para su exploración. De esta forma, tornase estratégico para una cadena productiva eficiente y eficaz que se realicen nuevos plantíos con bambús en áreas pasibles de proyectos de reforestación. A nivel mundial existe una lista de las principales especies comerciales de bambúes y sus distintas aplicaciones que pueden ser utilizadas como base para un estudio regional y local, permitiendo ampliar la gama de productos generados para atender el mercado. Estas especies pueden ser cultivadas en grandes plantaciones comerciales, los cuales permiten abastecer de forma estable una industria, viabilizando el aprovechamiento de las áreas agrícolas marginadas, o en proceso de degradación. Los plantíos de bambúes agregan beneficios ambientales, económicos y sociales para las comunidades rurales al aumentar la demanda de empleo. Al pretenderse aumentar la economía que gira alrededor del bambú, es de vital importancia destacar tres aspectos en los cuales se deben trabajar: 1) La generación de informaciones técnicas aplicadas al cultivo de los bambúes, considerando sus aplicaciones para las principales regiones agrícolas/forestales de América Latina; 2) La capacitación especializada de técnicos en el cultivo comercial y beneficiarios del bambú, por medio de cursos de pregrado, posgrado, talleres, seminarios, congresos y cursos on line, entre otros ; 3) La generación de productos de alta calidad, innovadores y de costo competitivo logrando la comercialización en el mercado internacional.

Sustainability = Environment + Society + Economy
Bamboo: a viable alternative for a sustainable future

Vietnam and Bamboo: Providing an alternative future to alleviate socio-economics and environmental issues

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Abstract

Vietnam faces many difficulties stemming from growing population and climate change. As a developing country it has come far in the past two decades, from being one of the poorest countries in the world. However, there are concerns that it will be difficult to maintain the positive trajectory it has been moving in. Identifying socio-economical and environmental context of Vietnam provides ways of speculating to improve the situations faced in Vietnam. An overview of climate change, greenhouse gases, deforestation, natural disasters, rising sea levels, diminishing soil quality, poverty levels, food security and building trends provides a picture of current circumstances in Vietnam. This paper then explores the potential of bamboo as a part of the economic and environmental ecology of Vietnam, beyond its use as a second grade building material. From investigating different applications and uses for bamboo, it is hoped opinions to alleviate some of the difficulties arising in Vietnam can be found. In particular, the ways in which bamboo can help reduce poverty in rural areas. This is extremely relevant to Vietnam, as two-thirds of its population live in rural areas, and where the rural poverty rate is 22% (Pham et al. 2017, p. 3). This paper attempts to identify bamboo as a useful and renewable resource and ways it could be implemented throughout Vietnam to mitigate the affects of climate change and positively affect socio-economic circumstances in the country.

The roles of bamboo Industry in enhancing Livelihood & Socioeconomics of the rural Community, Sarawak, Malaysia.

By JOHNEK AJONG HENRY

ABSTRACT.

In Malaysia bamboo is still treated as insignificant as nations has discard all major interest in bamboo research and development since the early 1990.s. In Malaysian forestry bamboo is still a minor non timber forest product less than that of rattan and in Malaysian plantation agriculture bamboo is listed as noxious weeds. REDEEMS embarks on bamboo initiatives by eatablishing a small community bamboo botanical park in 2007 and begin convincing Sarawak State government and Federal government authority about the benifits of bamboo ever since. REDEEMS is striving for Sarawak rural community socio economic re engineering by reintroducing bamboo initiatives into rural community livelihood industrial socio economic activity starting from mix agro forestry reaforestation plantation to industrial semi finish productions for bio composite lumber processing and empower rural community to earn their living at pal with the city communities in the nation drive for high income economy after 2020.

Somaclonal variation in *Dendrocalamus hamiltonii* as revealed by isozyme analysis

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Abstract

Dendrocalamus hamiltonii also called `Tama bamboo' or tufted bamboo, native to the Northeast Himalayas, is one of the twelve important species of bamboo recommended for large scale planting and also suggested for the wasteland development Chauhan *et al.* 1992 in India. Natural regeneration of this species is dwindling fast due to the generous use of existing bamboo resources for various household and industrial purposes. Therefore, immediate multiplication and conservation measures are required for safeguarding the existing bamboo diversity, ensuring their availability in the future and also for undertaking reforestation programs.

Tissue culture techniques combined with a mutagenesis treatment can speed up the breeding program for development of mutants/ new variants. Creation of somaclonal variants in this species would be a potential advantage to intended breeding for improvement. In the plant breeders perspective however, the bottom line remains ultimately that the genetic variability recovered from regenerated plants should result in a phenotype that is commercially useful. The present program would thus explore the possibility of exploiting economically useful somaclonal variation for subsequent integration into plant breeding programmes.

Isozyme profiling of Peroxidase enzyme was exploited to find out the diversity within mutagen treated samples of *D. hamiltonii* to assess somaclonal variation as induced by mutagens during callus organogenesis. Isozyme analysis revealed an overall of 40.59% polymorphism among the mutagen treated and control samples. A total of one hundred and one bands were resolved with maximum (six) loci in 0.05% EMS for 60 minutes. Loci PRX-1 and PRX-6 were monomorphic for all samples. Treatments 0.05% EMS for 60 minutes and 0.01% Colchicine for 60 minutes exhibited polymorphic Locus PRX-3

The pole gymnastic using bamboos

Yoshitada Kofuku
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Abstract
Bamboo is known to be used for a myriad of uses including sports and recreation. In recent time, pole gymnastics which is an acrobatic performance is gaining popularity in Japan. I conceived this pole gymnastic using bamboos 38 years before, and it was shown at Kobe Municipal Maiko Junior High School. Nowadays it is played at sport events in elementary and junior high schools in various part of Japan. The most important part for pole gymnastics is selection of the bamboo. The most suitable bamboo culm size for using in gymnastic is 4 meters in length and 6-8 centimeters in diameter. It is important to wrap the both ends of the pole with tape and to paint with color paint in respective group for the reinforcement of the pole. It ensures safety and also increases the shelf life of the bamboo. Pole gymnastics encompasses the following
(1) Bending and stretching exercise of an arm and a leg and the upper and lower movement
(2) The movement which is raised and supported
(3) The movement which pushes, pulls, hands, receives and twists it
This type of gymnastics also builds the muscle strength. To do the same movement, a sense of togetherness is born. It will be performed irrespective of physique difference, physical strength difference, sex, age distinction

Using bamboo culm for pole gymnastics has the following merits

(1) It's growing naturally in wide areas in the world.
(2) There is viscosity and it's hard to break, so it's safe.
(3) When it fits the condition, the bamboo species does not matter in particular
Another merit of the pole gymnastic is that the type of exercises is not limited and so we can create new exercise movement endlessly. It's possible to enjoy a pole gymnastic as physical culture in Japan as a group as well as individually. I am looking forward to being known through the 11thWorld Bamboo Congress, and I expect that all the countries we'll become fond of a bamboo through a pole gymnastic.

Arquitectura en tiempos de cambio climatic

Antonio R Leyva

Abstract

Millones de humanos habitamos este planeta. Todos aspiramos a disfrutar de esta vida, pero la forma en como lo hemos hecho, ha ocasionado como daño colateral, más 4 mil millones de personas en condiciones de pobreza y el colapso de nuestro entorno natural, el cual se manifiesta en el cambio climático, que pone en jaque la misma subsistencia de la humanidad. México es sensiblemente vulnerable al cambio climático no solo por su gran exposición a diversos desastres, desde deslaves, sequias, inundación, terremotos sino también por su limitada capacidad de respuesta ante tales eventos, desde los momentos previos al desastre hasta la recuperación completa de las comunidades afectadas.

Darwin explico que la característica principal de las especies que sobreviven a lo largo del tiempo, reside más que en su fuerza, en su capacidad para adaptarse. Hoy somos emplazados a adaptarnos a las nuevas y cambiantes condiciones del clima. Pero, ¿Cómo debemos adaptarnos? Desde los diques de última tecnología que pretenden proteger a New Orleans de las inundaciones, o las ciudades flotantes de los países bajos hasta la gran muralla de árboles con la que África pretende detener la desertificación de los suelos, son evidencias de la adaptación de diversas comunidades que se encuentran en la primera línea de batalla de esta nueva guerra mundial. La adaptación resilente determinara que sociedades prevalecerán al cambio climático. La adaptación resilente implica por un lado, la mitigación de los procesos que deterioran la cohesión social y la salud de los ecosistemas y por otro, impulsar los procesos que ayuden a la regeneración de ambos, sin embargo, también implica un profundo cambio en la forma en como concebimos nuestra vida, un cambio profundo en las personas que somos, un nuevo ser humano es requerido, una nueva sociedad entre humanos es requerida, una nueva sociedad con nuestro entorno natural, es requerida.

Este es nuestro tiempo, es nuestra lucha impulsar proyectos que mejoren la resiliencia de los asentamientos humanos ante la crisis social y el cambio climático.

Desde finales de los 90´s emprendimos esa búsqueda y en ella hemos adoptado al bambú como nuestra bandera, pues nos ha permitido entender la arquitectura, más que como un objeto, como un catalizador de distintos procesos que ocurren más allá de los límites del terreno en donde se emplaza y los cuales afectan positiva o negativamente el tejido social y su entorno natural. De esta forma, puede determinar la desertificación o la forestación de un suelo, el crecimiento de la económica corporativa o la diversificación de la economía campesina, el desempleo o empleo, la mitigación o la intensificación del cambio climático, la vulnerabilidad o la resiliencia. El bambú juega un papel determinante tanto en la regeneración de nuestro entorno natural, como mitigador de los desastres naturales que nos acontecen. La arquitectura regenerativa con bambú promete encontrar la prosperidad pacíficamente de una forma posible para todos.

Bamboo "cutting edge" technologies on behalf of Jewish Sacred writings.

Ran Lichtner, Bamboo-Center, Israel. Bamboocenter1@gmail.com

In recent years the ancient traditional writing method of sacred writings with cane has been rediscovered and has been adjusted to the latest "cutting edge" technologies replace by bamboo outer surface skin.

According to the Jewish tradition, writing with the cane was considered the preferred highest form of sacred writings.

This method of writing using the cane was neglected because of the small but critical fact that the cane (Arundo-donax) is too soft and would wear off quickly during the writing on Parchment (klaf).

This writing had to be accurate and continuous, forcing the writer to adjust often the tip of the cane, which created uneven writing.

Today , acquired knowledge and experience in the field of bamboo, combining my abilities and know-how with a significant number of Jewish traditional Scribes links the bamboo knowhow and the traditional writing in a long process of searching for the perfect pieces of bamboo that fit to the Sacred writings.

The good news are that we have achieved this goal recently, found and specified the exact bamboo species for quill and its exact parchment specification allowing its accurate performance to achieve this goal according to the traditional sacred writings, getting it the right size, sharpness, angle and the right flow of ink.

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My presentation and lecture will combine some traditional stories and methods along with my actual bamboo quills for the sacred writings.

VARIABLES DASOMÉTRICAS DE *BAMBUSA VULGARIS* SCHRADER EX WENDLAND Y LOS CRITERIOS E INDICADORES DEL MANEJO FORESTAL.

DASOMÉTRICS VARIABLE OF *BAMBUSA VULGARIS* SCHRADER EX WENDLAND APPROACHES AND INDICATORS IN THE FORESTRY HANDLING.

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RESUMEN

Con el objetivo de conocer el comportamiento, la disponibilidad y tendencias del desarrollo de la biomasa de *Bambusa vulgaris,* se estudiaron en Cauto Cristo, Río Cauto y Manzanillo; las variables dasométricas y su relación con los criterios e indicadores del manejo forestal sostenible; el presente trabajo propone un sistema integrado por 11 criterios y 45 indicadores , identificados, diseñados y definidos para controlar el desarrollo, de la biomasa aérea el manejo, aprovechamiento y uso sostenible de la especie a partir de sus características morfológicas, y los atributos de respuestas en razón de su condición de especie más naturalizada en el país, a través de las respuestas ambientales y tecnológicas de los indicadores empleados en las evaluaciones; los resultados obtenidos han evidenciado la posibilidad de implementar un sistema de Criterios e Indicadores específicos para dicha especie.

Palabras clave: Variables dasométricas, criterios, indicadores, especie, biomasa.

LA PRODUCCIÓN DE VITROPLANTAS DE BAMBÚ PARA EL MERCADO FORESTAL – UNA ALTERNATIVA SUSTENTABLE

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Introducción

El mercado forestal actualmente exige que sus plantaciones sean compuestas por material vegetal que cumplan con los requisitos de productividad, calidad y procedencia garantizada; además, que tengan una viabilidad que pueda atienda a las exigencias de esta área. La creciente demanda del mercado internacional por recursos renovables, asociado a su inadecuado manejo y aprovechamiento y deficiencias en el control por parte de los organismos responsables, han ocasionado la reducción drástica y en algunos casos, la pérdida de grandes extensiones de bosques naturales. Junto a esta reducción, ocurre una perdida biológica de valor incalculable.

Una alternativa para mitigar el avance sobre los bosques nativos, es la optimización de plantaciones comerciales de especies forestales de rápido crecimiento, capaces de producir productos similares a los producidos por los bosques nativos y que atiendan las necesidades del mercado. En este senario los bambúes presentan una opción económicamente viable.

Para la implantación de grandes plantaciones forestales de bambúes, es indispensable la disponibilidad de mudas en la cantidad y calidad deseada. Para esto, son preparados viveros forestales capaces de atender esta necesidad. La ausencia de floración frecuente en la mayoría de los bambúes comerciales y la variabilidad de las mismas han impedido la producción por semilla. Por eso, normalmente las plantas de bambúes son obtenidas por algunos sistemas de propagación vegetativa. De esta forma, la formación y producción en larga escala de un vivero forestal de bambúes, esta directamente relacionado a necesidad de la presencia de grandes extensiones de bosques de bambúes que sirvan de matrices. Para

contornar esta dificultad, la micropropagación de bambúes llega como herramienta que garantiza al productor, la producción de plántulas en la cantidad y calidad deseada. Entre las que podemos citar la garantía de su fidelidad genética y la calidad fitosanitaria del material inicial. Sabemos hoy que es posible, gracias al tamaño de las mudas, realizar el plantío mecanizado de bambúes. En el caso, especial de producción de mudas de bambúes para el mercado de especies ornamentales, la micropropagación permite un continuo suministro de plántulas durante todas las épocas del año.

La propagación vegetativa de los bambúes por micropropagación, llamado también de propagación *in vitro*, de igual forma puede y debe contribuir a la mejora del material cultivado en campo. Hoy, el bambú es considerado como el árbol del futuro y por lo tanto, necesitamos promover su cultivo. Sin embargo, la producción a larga escala de esta noble planta para el fomento forestal todavía necesita ajustes.

Visto tales consideraciones, este trabajo tiene como objetivo explanar temas como la producción de plántulas de bambúes, la viabilidad de las técnicas de propagación existentes, los avances de la micropropagación de los bambúes y la producción de vitroplantas de esta especie, además de algunas consideraciones pertinentes al tema.

Calculation of Large Bamboo Structures.

Ing. Armando Moreno Sánchez

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Abstract: first we must 100% of the architectural design, then analyze the bamboo in the laboratory. calculate loads, use structure calculation software, design connections, and the best way to transmit loads to the foundation.

Keywords: Bamboo, Calculation, Structure

1. Introduction

Is bamboo really the steel of the jungle?

According to the tests made in the materials resistance laboratory of the UNAM, the behavior of bamboo is not like concrete or steel, nor wood, it's behavior is more like neoprene.

The purpose of this is to share professional experiences in the design of bamboo structures from a small to large structures.

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2. Methodology of structural calculation.

2.1.- Preliminary: Having 100% of the architectural design and having the opinion of the structural engineer that considers the recommendations of the structural design manuals. (Figure 1)

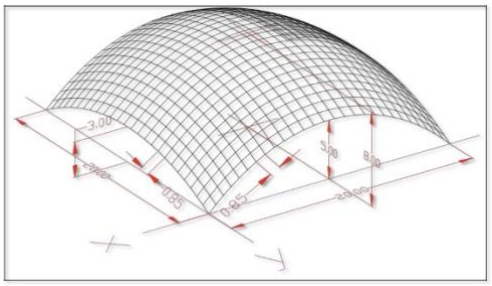

Figure 1. Architectural design.

2.2. Laboratory analysis: The bamboo will be analyzed in the laboratory to obtain resistance data, volumetric weight, elastic modulus, poisson module.

2.3. Information:

- Andean Code for wood design
- Materials resistance books
- Structure analysis sofware
- Manage and interpret finite element modules.

• Local construction regulations, and the CFE manual (Figure 2).

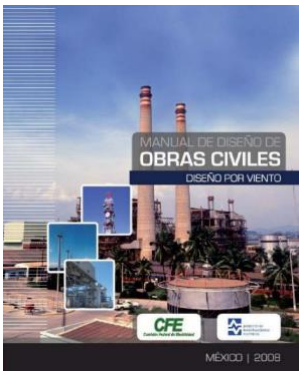

Figure 2. CFE design manual.

2.4. Loads:

• Permanent (own weight)
• Accidental loads (wind, earthquake, hail and live load)
• Security coefficient
• A 3d model.
• Compare with laboratory.

2.5. Connections: the fine part of the analysis because the shear parallel to the fiber of the bamboo is extremely low.

Also take care of the length, avoiding deformations.


Figure 5. Tension cable.

2.6. Foundation:

• Vélez type connection
•Steel profiles

3. Conclusions

Bamboo is an appropriate for large structures, we must brake paradigms.

With the software, research, engineering, laboratory support, materials can be worked to the limit within the established safety parameters.

BIBA®: HOUSING SOLUTION BASED ON BAMBOO PREFABRICATED CONSTRUCTION SYSTEMS

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Abstract
This work presents the issues about the construction industry in Mexico and the world, the importance of rescuing and validates vernacular building systems to provide sustainable solutions to the housing deficit in Mexico and a little overview of bamboo construction and bahareque technique. The companies Kaltia Consultoría y Proyectos S.A. de C.V. and Bambuterra S.A.P.I. de C.V. are developing a construction system called BiBa® (Biopanel®/Bambulosa®) composed by prefabricated systems for shear-wall, floors and roofs with bamboo and other materials. The shear-wall system is called Biopanel®, for this system a structural validation is under way, including static and cyclic lateral load test on Biopanel® shear-wall prototypes and; free and ambient vibration test and cyclic lateral load test on two story buildings made of Biopanel® shear-wall prototypes, from which state-of-the-art structural design methods are being developed. Besides, Biopanel® was developed following eco-design criterions in order to obtain a sustainable production and a more rational resource use. The floor and roof system called Bambulosa® was also structurally validated through experimental testing from which design equations were developed. A life-cycle assessment was applied on both products to evaluate the environmental aspects. BiBa® system and its components (Biopanel® and Bambulosa®) was already successfully used in several edification projects.
Keywords: Bamboo, Construction, Prefabricated systems, Seismic design

Sobre el Bio-Diseño y Cálculo Estructural Normatizado con Guadua

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Planteamiento:

Existe una relación directa entre el bio-tipo de guadua elegida y su parte comercial, con sus características inherentes, detalladas por laboratorio biológico, con respecto de un determinado diseño estructural a ejecutar, en razón de la carga a soportar por las columnas, y las luces permisibles de las vigas.

Se tratarán los bio-tipos de la especie Angustifolia Kunth colombiana; Macana, Castilla, Rayada Amarilla, Cebolla y Verde Común. Se explicará al público dichas características para que aprendan a bio-identificarlas, a conocer sus espesores de pared, sus diámetros promedio, su cantidad de fibras aproximadas por cm2, y de acuerdo a resultados de laboratorios de ingeniería, las capacidades de resistencia por largo de 3 metros (suficiente altura para una vivienda) a cargas a Compresión, Tracción y la variabilidad de sus Módulos de Elasticidad a compresión, tracción y flexión.

Se explicará qué es y cómo obtener un área de Cuadro de Carga para una columna; lo cual redundará en un diseño geométrico de la misma, y por ende de toda la estructura. Esto conlleva a tener toda una clase previa de diseños de columna y de vigas.

A ello se añadirá los porcentajes de exigencia gubernamental para protección anti-sísmica, utilizando cálculos simples entendibles para cualquier persona.

El objetivo primario es formar técnicos especializados con capacidad básica de cálculo estructural, lo cual redunda en mejores calidades de obra, una clara responsabilidad civil y legal, y oficinas de Planeación con dichos soportes de diseño y cálculo de ingeniería.

Conclusiones:

Aunque es un inicio y solo algo que se viene aplicando con éxito en Colombia, es una ventana para investigadores de otras naciones, y les muestra camino para comenzar a estudiar más a fondo sus especies nativas en cuanto a la relación de cualidades biológicas con capacidades de cargas estáticas.

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Mexican bamboo species to the San Diego Zoo

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Abstract

Here we present a program to collect and to export eight endemic Mexican woody bamboo species (*Otatea reynosoana, Otatea transvolcanica, Otatea nayeeri, Otatea victoriae, Otatea rzedowskiorum, Guadua inermis, Chusquea nelsonii, Chusquea cortesii)* to the San Diego Zoo. The main goal is to do *ex situ* conservation of those native and endemic woody bamboo species. The species will be: display for educational purposes for the visitors and as well as preserving those bamboo species. Propagation of imports to preserve species, new introductions and new taxa discoveries that will enhance the SDZG Bamboo collections in addition to distributions through networking affiliates. Our objectives are: 1) Collect living specimens for the San Diego Zoo, Francisco Javier Clavijero Botanical Garden and Botanic Garden of the Instituto de Botánica de la Universidad de Guadalajara. 2) Make herbaria collections for those eight species that will be deposited at the IBUG, MEXU and XAL herbaria. 3) Do field work observations about the risk status of those eight species to evaluate any inclusion in the Red List of the IUCN. Plant systematics using taxon diagnosis to evaluate and determine whether any collected taxon is endangered or threatened. 4) Preserve, import trough the USDA and propagate both *in situ* (Mexico) and *ex situ* (SDZG). 5) Adherence to the Global Strategy for Plant Conservation targets in addition to the mission goals of the CPC (Center for Plant Conservation). We expect to publish one scientific paper and two diffusion articles. The new introductions to the USA (San Diego Zoo) will be presented as products for further scientific research, herbaria sampling deposits, DNA sampling, invitro/micropropagation and cultural propagative methods primarily for conservation, education, display, collection, and flowering monitoring.

Key words: *Chusquea*, *Guadua*, Mexican woody bamboo species, *Otatea*.

Interactive Effect of Growth Regulators and Rooting Media on Propagation of *Dendrocalamus strictus* (Roxb.) Nees

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Abstract

A bamboo is a group of fast growing woody plant species which is of vital importance from ecological, commercial and socio-economic points of view. Bamboo has a unique position in terms of its diversity, distribution and uses. The demand of bamboo has risen tremendously but its resources are shrinking day by day in the country mainly due to its gregarious flowering/seeding and subsequent dying nature.

Dendrocalamus strictus (Roxb.) Nees is a tropical and subtropical clumping species native to Southeast Asia. It finds myriad of uses both in the urban and rural sector of India. The mass scale use of this species by paper mills in India has led to a situation where replacement and raising of new stands have fallen way behind the rate at which the bamboo clumps are being cut. Flowering after prolonged periods is another factor which gives rise to the added impetus to the already urgent need for its mass multiplication as much of its flowered forests are now barren.

In the current study bamboo propagation through branch cutting (an attractive alternative to seed/ offset/ rhizome propagation being a cost effective and popular method) was carried out. The cuttings were treated with different rooting hormones (200 ppm) and planted in a combination of various rooting media. Sprouting of the branch cuttings was observed within a week of the plantation and it took 45-60 days to develop roots. Rooting in the sand medium was found to be better and faster than soil medium. The interactive effect of growth regulators and rooting media depicted the best response in the rooting medium comprising of sand + vermiculite treated with IBA. Further, the proliferation of the propagated shoots was carried out using macro proliferation technique.

Title: The Use of Regional and Local Bamboo as a Sustainable Economic Opportunity

Authors: Dr. Jaime Jesús Rios Calleja (1); Mtro. Diego Ariel Riva (1); Zayra Georgina Valencia Ramírez (1); Ricardo Sarabia Hernández (1); Adriana Torres Camacho (1)

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ABSTRACT:

The Initiative 8.2 is a group of academic, administrative members, students, and councillors from the Benemérita Universidad Autónoma de Puebla (BUAP) from architecture and other departments working in a multidisciplinary scheme in collaboration with NGO's, enterprises, civil associations as well with local governments. It attends habitat issues related to natural disasters.

Due to recent natural disasters occurred in last September 2017 in Mexico with 3 earthquakes between 6 and 8.2Mw causing mayor damages in the states of Mexico, Morelos, Puebla, Oaxaca and Chiapas, 8.2 has set a program to develop resilient sustainable housing program attending families affected.

Chietla is one of the municipalities of the Izucar-Atlixco valley region in the state Puebla. It was one of the most affected municipalities in Puebla after the second earthquake being very close to the epicentre registered in Axochiapan, Jonacatepec, in the neighbour state of Morelos.

Chietla is a marginal community with high levels of extreme poverty, and poverty indicators with 11.4% of extreme poverty, 47.6% of moderate poverty and 28.2% of the total population considered socially vulnerable (Zamora Saenz 2017; Sedesol, Coneval 2010), Related to housing figures, 21.9% lack of drinkable water, 12.4% have earthen floors, 6.3% suffer overcrowded conditions, 5.1% lack sewage services, 1.2 lack electric power, and 2.1% has none of the basic services (Sedesol, Coneval 2010).

Five initial homes were built in Chietla, using natural renewable materials such as bamboo based on the NSR-10 seismic norm from Colombia (ACIS, 2010) and pallets from automobile industry from Puebla, filled up with plastic bottles used as envelope.

Preliminary results have shown that co-working with the community as well as using appropriate technology and technology transfer programs from universities can activate productive opportunities for the communities working with and researching local bamboos as a sustainable building material.

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CONSTRUCCION DE VIVIENDAS CON EL SISTEMA QUINCHA

ALVARO ROLDAN CHAPARRO

El sistema constructivo LA QUINCHA consiste en combinar guadua, madera, tierra y cemento para entregar casas y de uno (1) y dos (2) pisos, con paneles de madera en modulaciones de 1.20 cms. de ancho por 2.30 cms. de altura y de éste se derivan otros como el medio panel, panel puerta, panel ventana, panel luseta y panel cumbrera. Las guaduas son escogidas por su diámetro, tamaño y se cortan en su debido tiempo y se someten al secado, preservado y luego al labrado en latas. (Láminas de guadua adelgazada y pulida rústicamente).

Después continúa el trabajo de armar los paneles en madera, se le insertan las latas de guadua trenzadas, quedando un marco rígido que hará las veces de muro portante y se continúa con la armazón de la estructura portante, sostenida sobre las zapatas y vigas de cimentación. Luego se le aplica la tierra arcillosa seleccionada y amalgamada en proporciones precisas con fique, ceniza, arena y cemento. Se deja secar y se instala malla de gallinero por ambas caras del panel y sobre ésta aplicamos el repello (mezcla de arena, cemento y agua).

La cubierta puede ser de teja de barro, asbesto-cemento, zinc o palmicha, que estarán apoyadas sobre la estructura de las guaduas a la vista con caña brava. Las instalaciones hidráulicas, eléctricas y sanitarias quedan completamente embebidas entre las paredes del sistema y se le puede dar cualquier tipo de acabado a las superficies de las mismas.

Una vivienda de 50 metros cuadrados se logra construir en 5 (cinco) semanas.
El costo por metro cuadrado de construcción es de **US $ 170** (**Ciento setenta dólares**), incluye este valor la casa completamente terminada con el piso en baldosa de cemento, paredes pintadas, baño y cocina enchapados y la carpintería de madera en puertas y ventanas. Por lo tanto el valor de la vivienda de cincuenta (50) metros cuadrados es de **US $ 8.500 (Ocho mil quinientos dólares).**

Este valor se puede disminuir en un treinta (30%), o sea US $ 6.000 (Seis mil dólares) si se vincula la mano de obra de los beneficiarios.

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Armado de panel con latas

Armado de muros

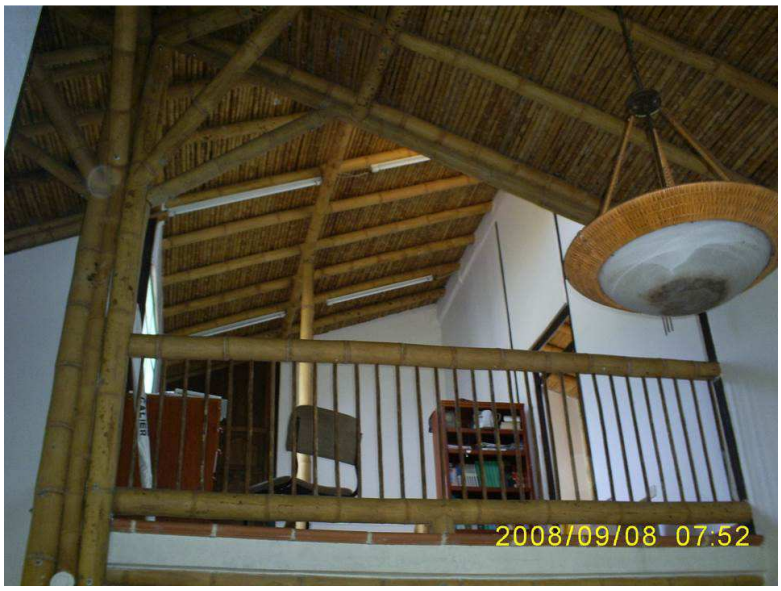
Aplicando barro al muro

Muros en proceso de secado

Acabado de la cocina

Fachada estadero

Fachada de dos pisos



Balcón interno

Fachada de dos pisos

Fachada de un piso

Fachada con techo curvo

Cocina – comedor

Diseño y construccion

Arquitecto (PhD) Universidad Politécnica de Cataluña UPC

Abstract

The present paper aims to review the issue of construction of bridges in bamboo-guadua in Colombia and China. From the description and analysis of three (3) cases of bridges already built, two (2) of which are projects designed by the renowned architect Colombian Simón Vélez, considered as *"The guru of bamboo in the world"* and a third case of a bridge which has just built in the municipality of Yumbo (Department of the Valle del Cauca) in which I participated as an architect Designer (in the company of other two architects) and in the supervision of the construction project. From this analysis is intended to have a clearer view of the proper use of a material that is as versatile as the bamboo, in this case particularly of *Guadua Angustifolia Kunth*species. No surplus highlight that Colombia is one of the countries considered as *"Paradigm in architecture, engineering and construction with bamboo"* one of the conclusions that arrojo my Doctoral thesis entitled: present and future of the bamboo architecture in Colombia: "*Simón Vélez Símbolo and search for the primitive,"* dirigida by Dr.Arq. Jaume Avellaneda-Grande in the Polytechnic University of Catalonia UPC (Barcelona - Spain year 2006).

Estimation of the above ground biomass of *Arundinaria alpina*: Indigenous bamboo in Kenya

EDITOR'S NOTE: According to The Global Checklist of Bamboo and Rattan (Kew & ICBR) CABI 2017, the proper nomenclature of this species is *Oldeania alpina*

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Abstract (300 words max)

Kenya Forest Service (KFS) is the organization that manage the forests in Kenya. KFS sets The Forest Stations in each counties to manage the forests. Forest Station has set on basically for the forest conservation. On the other hand, KFS provides local resident the common use area as Pelies in the Forest Station, because of the demands of local resident forest use.

Actually, wood resources demands has increased due to rapidly population growing in all over Kenya since 19th Century. KFS had tried to satisfy this problem due to several wood producing projects. However, previous effort which selected the introduced tree species to plant made negative impact in primary environment, because of invasive characteristic of the planting tree.

Kamae is the area where located in central Kenya, Kiambu County. Kamae forest station is the habitat of *Arundinaria alpina*. *Arundinaria alpina* is only one indigenous bamboo species in Kenya. This bamboo is used by local resident for their livelihood use. Bamboos are known as the useful wood recourses which growing faster than common trees. However, the ecological characteristics of *Arundinaria alpina* is unknown enough to consider about the management of this bamboo.

In this study, to understand the current situation of *Arundinaria alpina* and local people impact. We have estimated the allometly correlations between diameter of breast height (DBH) and above ground biomass (AGB) of *Arundinaria alpine* in Kamae. Then, compared with the conservation area and Pelies bamboo forest's AGB each and discussed about the characteristics of this bamboo.

The results shows that this bamboo's AGB was estimated by this formula $AGB=0.2929e^{0.5726DBH}$($R^2=0.7204$). Conservation area's bamboo AGB was estimated as 39.73t/ha. Pelies's AGB was 35% lower than conservation area and it was 23.61t/ha. It indicate that current local residents bamboo use has remaind about 65% from unused bamboo forest.

Keywords: Bamboo, Kenya, Above ground biomass, Indigenous species, Resource uses

El bambú en la reducción de riesgos de desastres _ caso: construcción de locales comunales en el distrito de carabayllo, lima-Peru

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Abstract

En los últimos 25 años Lima ha sufrido el crecimiento desordenado de la ciudad y se ha dado el posicionamiento de las laderas, frente a un proceso de migración de ciudades del interior del país hacía la capital. Considerándose estos sectores lo más urgentes por atender y poder cubrir las necesidades básicas de una vivienda familiar: saneamiento y electrificación. Quedando relegado el posicionamiento, materialidad y sistema constructivo de la vivienda, siendo estos factores importantes frente a un peligro sísmico.El trabajo de intervención estuvo planteado en el Distrito de Carabayllo, Región y Provincia de Lima y tiene como punto inicial de estudio la reducción de riesgos de desastres, utilizando bambú como el principal material de construcción, considerando que Lima tiene cerca de 2.8 millones de personas viviendo en las laderas de los cerros (parte alta de los cerros en pendientes muy pronunciadas y/o ubicadas en quebradas), a la vez Lima se encuentra cerca a la Placa Nazca y Continental y aún no se ha vivido un terremoto de la magnitud esperada en los últimos 260 años. Fueron elementos suficientes para considerar la construcción de Locales Comunales con características antisísmicas y la intervención estuvo financiada por la ONG Save the Children International y por USAID.Por consiguiente, se realizó una intervención en una zona del Distrito de Carabayllo: El Progreso. Cuyo objetivo general: Difundir la inserción del bambú para reducir riesgos de desastres ocasionados por fenómenos naturales en las construcciones de poblaciones vulnerables. Con la meta: Aplicando la metodología capacitación para edificación segura y con la participación de la población de zonas vulnerables de Carabayllo, se reduce el problema de construcción insegura. Dicha intervención, abarca tres campos: El aspecto social, gestión de riesgos de desastres ocasionados por fenómenos naturales y la arquitectura (sistema constructivo con bambú). Para ello, se realizó todo una etapa inicial de capacitaciones y talleres de sensibilización para que puedan conocer el programa y poder incorporarse como beneficiarios del monto estipulado como donación. Posteriormente se tuvieron capacitaciones y talleres a la población para que logren conocer cómo se construye en bambú, posteriormente la población realizó la construcción integral de los Locales Comunales que estarían ubicados en su comunidad, de esa manera se lograba construir mayor cantidad y sólo invertir el dinero de la donación en materiales y equipos necesarios en la obra. Todos los proyectos tuvieron distintas fases de inicio y de culminación, ya que se dependía mucho de la organización para que puedan realizar los trabajos los fines de semana, el tiempo aproximado de duración fue de 5 meses.

Economy - Business & Innovation

Don't wait for change, create it with bamboo!

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Abstract

Bamboo grows naturally in Uruguay and there is an abundance of it but there is no tradition, culture or commercial industry of using bamboo as a resource. So I took this opportunity to create Nuestro bambú, with this venture I was selected to become one of the 250 Young Leaders of the Americas Initiative Professional Fellows 2017 from Latin America and the Caribbean, to travel and collaborate with counterparts in businesses and civil society organizations in 24 cities across the United States. The leanings were about entrepreneurship, build leadership skills, sustainability and validate the business model and work of Nuestro bambú creating sustainable impact to contribute to social and economic development in my community and can scale it to everywhere that have bamboo!

Keywords: bamboo in Uruguay, sustainable impact, entrepreneur, create change, expand your voice.

Industrial Uses of Bamboo: Furniture and Houseware Industry

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Abstract

The study aims at the promotion of the usage of bamboo as an alternative for metal and plastic for contemporary designing and production of mainly hanger accessories that use simplistic methods of creation with the minimum usage of synthetic material.

It has been an age-old tradition of using bamboo for the making of basic goods like baskets, hats and different decorative objects which are of low quality and have no significant branding or packaging. It is also seen how artists have been ignorant in the development and exploration in this field along with no environmental consequence in mind. The aim is to blend tradition with luxury for a better lifestyle. The usage of the versatile bamboo helps in creating a fusion of tradition with extravagance.

The practice of using plastic, metal and substandard synthetic raw material decreases the quality and durability of the product. We also overlook the amount of wastage that these hangers produce because they are invisible to the consumers as the hanger companies are very quiet about their extreme wastage stream. Furthermore, the hangers are of average quality and no efforts are put into its designing for the luxurious market; the study proposes the use bamboo over other raw materials to reduce the wastage by fashioning bamboo into contemporary designs that also depict my personal ideas and stories through the hangers and are more durability, recyclable, reusable and have modern forms with admirable finishing.

Keywords: Bamboo, alternative, contemporary, fusion, wastage, reusable, recyclable, upcycle

Procedure for obtaining of release agent for manufactured items with bamboo fiber - bamboo (Angustifolia kunth)

Authors: Lic. Florence Edwardian Speck Garzon Eng. Rafael Hernandez Martinez

Summary:

This technological invention with vegetable fibers is becoming a really striking alternative for industrial applications. This product that serves as an alternative to desencofrar the elements obtained from bamboo, us is useful, since it facilitates the same and is very economical; These manufactured objects are with view to replace plastic in the trade, as it would help the environment and the conservation of climate conservation of climate and its weight is light and facilitates the degradation.

From the economic point of view, the use of this aqueous release is benefit environmentally avoiding the accumulation of industrial waste.

Introduction in the last decade has risen significantly biopolymer materials using in the most diverse applications, it is important the advantage this gives us against other materials, its low costs and its low density (4.12) and its weight is easy to handle; in practice this product improves the properties of the materials giving good appearance and finish. Several studies coincide in pointing out the advantages of using this product in the this product in the desencofra operation thereafter. It is designed to be applied in metal moulds, ceramic molds, prefabricated, non-toxic, and it is eco-friendly.

The objective of this work is to contribute to desencofrar the objects obtained from the fiber of bamboo - guadua giving a nice ending to our view, in order to increase productivity and marketing.

General objective

test in the plant of prefabricated boyero (cuba) belonging to the Ministry of construction and in the centers of handicrafts from tip, shows us that at the end of this time, this product maintains all the properties Chemical Physics at the time of your application. Since shaking the same mixing behaves evenly (in terms of its composition) and its application, and can be used repeatedly without any change, giving a shine to the object an shine to the object and softness was easy.

Key words: mold release, biopolymers.

Procedure for obtaining pigments for bamboo ceramics for the conservation of the environment.

AUTHORS: LIC. FLORENCE EDUARDINA SPECK GARZON
ING. RAFAEL HERNANDEZ MARTINEZ
ESP. PAULA VIVIANA HINCAPIE CORREA

Summary:

The use of liquid and solid residuals accumulated in the industry is an increasingly complex problem, however with the present experience it is aimed at providing a solution for. So we investigated the large number of galvanic workshops and different galvanotechnic functions, such as: nickel plating, chrome plating, without cabling, tinning and plating among others. Which generate a considered volume of residuals that are very harmful to the environment, both liquid and solid.

The essence purpose is to give it an industrial use through obtaining pigments and using them in bamboo ceramics.

Galvanic residuals are used in the industry of construction materials, ceramics, and artistic ceramics in general.

On the other hand the different range of colors obtained in the laboratory area, can be applied in the enameling area of bamboo ceramic workshops and other paintings.

Introduction

The process of obtaining pigments for enamels for bamboo ceramics and other paints; from galvanic residuals, it contributes to environmental sanitation and improvement of the standard of living of humanity.

Achieve the production of ceramic pigments for bamboo ceramics and other paints through the use of galvanic residuals, and obtain these pigments through a technological process endorsed by scientific research and requirements raised by Citma (Cuba).
In summary to achieve an economic development to the territory and the country through the sustainable resource of bamboo. From Cuba to the world.

Procedimiento de obtención de pigmentos para cerámica de bambú para la conservación del medio ambiente.

AUTORES: LIC. FLORENCIA EDUARDINA SPECK GARZON

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Resumen:

El empleo de los residuales líquidos y sólidos acumulados en la industria, es una problemática cada vez más compleja, sin embargo con la presente experiencia se tiene como objetivo brindar una solución para. Por lo que se investigó la gran cantidad de talleres galvánicos y las diferentes funciones galvanotecnia, como son: el niquelado, cromado, sin cado, estañado y plateado entre otras. Las cuales generan un volumen considerado de residuales que resultan muy nocivos para el ambiente, tanto líquido como sólido.

El fin esencia es darle un uso industrial a través de la obtención de pigmentos y emplearlos en la cerámica de bambú.

Los residuales galvánicos son utilizados en la industria de materiales de la construcción, cerámica, y cerámica artística en general.

Por otra parte la diferente gama de colores obtenida en el área de laboratorio, puede ser aplicada en el área de esmaltado de talleres de cerámica de bambú y otras pinturas.

El procedimiento de obtención de pigmentos para esmaltes para cerámica de bambú y otras pinturas; a partir de residuales galvánicos, contribuye al saneamiento del medio ambiente y mejoramiento del nivel de vida de la humanidad.

Lograr la producción de pigmentos cerámicos para la cerámica de bambú y otras pinturas a través de la utilización de residuales galvánicos, y obtener estos pigmentos a través de un proceso tecnológico avalado por las investigaciones científicas y requerimientos planteados por el Citma (Cuba).

En síntesis para lograr un desarrollo económico al territorio y al país a través del recurso sustentable del bambú. De Cuba para el mundo.

Name of the Theme: 1.1. Taxonomy & Morphology

Relationship of the West Indian species *Arthrostylidium farctum* to other Neotropical woody bamboos.

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Abstract (300 words max)

Arthrostylidium, a Neotropical genus of 31 mostly clambering woody bamboo species, is a member of subtribe Arthrostylidiinae. *Arthrostylidium* has long been a catchall for species that are thought to be members of Arthrostylidiinae, but cannot be unambiguously placed into one of the other genera of the subtribe. Owing to this history, several species of *Arthrostylidium* have extraordinary morphologies. One particular case of this is observed in the West Indian species *Arthrostylidium farctum*, which has stiff, thread-like leaves emanating from the nodes giving the plant the appearance of pom-poms arranged along the culm. *Arthrostylidium farctum* is sometimes called "old-man's beard" in reference to these clusters of branch complements, but is also known by the name tibisi, a Taino word describing plants good for making baskets and fish traps. We investigated the relationship between *A. farctum* and other Neotropical woody bamboos using detailed morphological, anatomical and molecular analyses. We generated a phylogenetic tree based on four chloroplast DNA markers (ndhF, trnC-rpoB, trnD-trnT, rps16-trnQ) and recovered *A. farctum* as forming a well-supported clade with sister species *A. angustifolium* and *A. pinifolium*. Parametric bootstrap tests uphold this topology as significant. Detailed analysis revealed that these three species also share morphological and anatomical characteristics, which supports the phylogenetic result. Our findings reinforce the diagnostic value of leaf anatomy for identification and classification among the Neotropical woody bamboos, and help to improve the disordered taxonomy of *Arthrostylidium*.

Keywords: Arthrostylidiinae, Caribbean, Guaduinae, phylogeny, taxonomy, tibisí, West Indies

Theme:3)Economy 3.1 Industrial uses of Bamboo **or** 3.4 Infrastructure, Machinery and technologies

Advances In Industrial Processing Of Bamboo For Roofing Sheets

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Abstract

Extensive investigations were carried out at IPIRTI (Indian Plywood Industries Research and Training Institute) to develop Bamboo Mat Corrugated Sheet (BMCS) from eco-friendly material bamboo. Based on the studies, Pilot plant size dies were got fabricated in the conventional Plano milling machine with profile cutters. After successful trials the technology was commercialised way back in the year 2003. However, there were issues about surface smoothness and compactness of BMCS during commercial scale production. Subsequently after a few years to cover the roof top and corners, an eco-friendly ridge cap was innovated, accordingly Bamboo Mat Ridge Cap (BMRC) was designed and got fabricated in a state of art CNC 3 axis profile milling machine. Studies were carried out to optimise process parameters for the manufacture of BMCS and BMRC using woven bamboo mats. Sheets were subjected to rigorous test for evaluating bond integrity, performance tests like load bearing capacity, water permeability, resistance to boiling water, fire resistance and weather endurance. BMCS and BMRC were found to possess excellent load bearing capacity and meets the requirements as per IS 15476: 2004 (Indian Standard Bamboo Mat Corrugated Sheets — Specification). One distinguishing aspect of innovated BMRC is smooth and compact surfaces compared to original BMCS owing to CNC machined dies used for the former. The new improved CNC machined BMCS dies with larger size is designed now to meet the customer requirements of smooth and compact surfaces and to reduce roof overlaying cost and wastage. Soon the technology for the same will be passed on to the industry. The cost of the CNC profiled dies will go up by 50-70% nevertheless it will offset the cost with improved surface finish and reduced finishing cost for coating the BMCS due to very smooth surface.

BMRC and BMCS roofing sheet have enhanced characteristics like toughness, resilience and ductility. Apart from this BMCS is environment friendly, energy efficient and possesses good fire resistance. The BMCS and BMRC developed are first of their kind in the country and are adopted commercially by two units in India and one in Nepal. BMCS holds the Indian Patent where as for BMRC accord of Patent is awaited. Agencies like Indian railways, and other Govt. organizations are major buyers of BMCS and BMRC at present in India.

Key words: Bamboo, Corrugated Dies, Hydraulic Hot Press, Corrugated sheets, Ridge cap, Roofing

Proyecto habitacional tecun Umán:

Abstract

En Guatemala se desarrolló una de los proyecto habitacionales con bambú mas grande de américa, en los años correspondientes 2009 al 2011 se construyeron 600 viviendas de bambú de la especie ***Dendrocalamus asper*** y ***Guadua angustifolia,*** dichas viviendas son de 45 metros cuadrados (dos habitaciones, sala comedor y un baño) el costo de la inversión por casa es $3,500 el área de la construcción fue una área colindante con México donde la tormenta Stand daño muchas viviendas dejando a mucha gente sin casa, el beneficio social fue de 600 familias Guatemaltecas. El proyecto estuvo ejecutado por el centro educativo el bambú Guatemala el cual tenía dos contrapartidas el gobierno Taiwanés y el ICTA Instituto de ciencia y tecnología agrícolas.

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Japanese arrow bamboo (*Pseudosasa japonica* var. *japonica*) and its utilization in traditional Japanese archery

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Abstract
Japanese arrow bamboo (*Pseudosasa japonica* var. *japonica*) has been used for centuries in Japan to make arrows. In the past, other bamboo species have been used, but Japanese arrow bamboo remains the preferred bamboo. However, the majority of arrows in Japan are now made of other materials such as fiberglass or carbon. Some top-level archers still use bamboo arrows, and these are made by a small group of expert arrow makers called *yashi*. The number of active *yashi* in Japan is declining and this study will help to highlight their plight.
We examined and compared 80 arrows from around the world to identify the characteristics that make Japanese arrow bamboo the material preferred by *yashi*. We also interviewed five *yashi* to understand the process they follow when making arrows.
It is believed that there is a strong association between the *yashis'* level of skill and the specific characteristics of Japanese bamboo arrows. Thus, we focused on *yashi* and the techniques and skills required to make bamboo arrows. In this way we could clarify the relationship between their skills and the characteristics of Japanese bamboo arrows to better understand how Japanese traditional culture relates to the natural environment.
Our comparison of Japanese arrow bamboo with five other bamboo species revealed that the height of the nodes on Japanese arrow bamboo is generally smaller than that of other bamboo. Our interviews with *yashi* also showed that this is why they choose Japanese arrow bamboo. We found that while the actual harvesting of bamboo and the steps in the arrow-making process are relatively simple, the skills required to make high-quality arrows are not.
We shed light on the dying art of arrow making in Japan while also revealing the advantage of Japanese arrow bamboo over other species.

Keywords: Yashi, ethnobotany, traditional Japanese culture, martial arts

Introduction
Japanese arrow bamboo (*Pseudosasa japonica* var. *japonica*) is an important plant resource in Japanese archery. Although its origin is unknown, Japanese arrow bamboo is found in many areas in Japan including Honshu, Shikoku and Kyushu islands (Kobayashi 2017). It grows to 3–5 m with the internodes growing to 20–30 cm. Japanese bamboo arrows were first used in the Kamakura era (1185-1333 A.D.). Even after the introduction of guns around 480 years ago, the Japanese military has continued to use Japanese archery and Japanese arrow bamboo to make arrows. During the Edo

era (1603-1868 A.D.), Japanese archery was formalized and recognized as one of the important skills and martial arts for Samurai warriors (Matsuo 2013).

During that period, local government and militarized temples sought to retain the habitat of arrow bamboo and cultivate the species in certain areas under the supervision of the central government. Although the species are widely distributed in Japan, their habitats are now largely under human control. The need for Japanese arrow bamboo changes according to human demand for items such as weaponry. Following the end of the Edo era, Japanese archery was not longer just for warriors; citizens also began to enjoy the sport. Although Japanese archery was temporarily prohibited just after World War II under GHQ policy, Japanese archery is now considered traditional Japanese culture (Matsuo 2013).

Japanese archery is now mainly performed at traditional festivals and as a recreational sport. The majority of Japanese archers now participate in the activity as a sport, and the equipment used has been somewhat modernized. Originally arrows were made of Japanese arrow bamboo, but today most are made of duralumin, industrially processed carbon or fiberglass, and Japanese arrow bamboo is now rarely used. A few top-level archers still use arrows made of Japanese arrow bamboo in a limited number of top-level competitions. Furthermore, such arrows continue to play an important role in traditional Japanese culture and are used by core groups of top-level archers. These sophisticated arrows are made by a small number of expert arrow makers called *yashi*.

The number of practicing *yashi* may soon decrease even further because of the change to artificial materials. Traditionally, *yashi* produced many bamboo arrows, as well as those used for top-level competitions. Such bamboo arrows were also used for practice by 'regular' players. However, the demand for bamboo arrows has decreased because of the use of artificial materials. As a result, the production of bamboo arrows has decreased along with the number of *yashi*. At present, although the precise number is unclear, there are only 10 *yashi* capable of producing such sophisticated arrows. Thus, they are at risk of disappearing altogether. In most cases, *yashi* make bamboo arrows independently and are not part of any association; therefore, the overall current situation is difficult to determine. Their skill in making bamboo arrows is considered to have a strong relationship with the characteristics of Japanese bamboo arrows, and it is important to clarify this relationship to understand how Japanese traditional culture relates to the natural environment. This relationship, however, still remains unclear. Thus, the present study focuses on *yashi* and the techniques and skills required to make bamboo arrows. The objective of the study is to clarify the relationship between their skills and the biological characteristics of Japanese arrow bamboos.

MATERIALS AND METHODS

To better understand the peculiarities of Japanese bamboo arrows, we examined various types of arrows from around the world held at the National Museum of Ethnology in Osaka, Japan. A total of 80 examples from various regions were studied; we recorded the length of each arrow and the material it was made of.

To determine the quality of Japanese bamboo arrows we compared them with arrows made from other bamboo species. Specifically, we looked at the length of the internode, the diameter of the internode (a), and the diameter of the node (b) at 0.1 m and 1 m in height for six bamboo species (*Phyllostachys nigra* var. *henonis*, *Pleioblastus simonii, Pleioblastus linearis, Pseudosasa japonica* var. *japonica, Sinobambusa tootsiki* and *Semiarundinaria fastuosa*). These are endemic species in Japan. The following samples were studied: eight *Phyllostachys nigra* var. *henonis*, 10 *Pleioblastus simonii,* 10 *Pleioblastus linearis*, 24 *Pseudosasa japonica* var. *japonica*, 10 *Sinobambusa tootsiki*, and eight *Semiarundinaria fastuosa.* After the measurements were taken, we calculated the height of the node using "b minus a".

An interview survey was conducted with five *yashi*. The five *yashi* each lived in different areas of Japan, and the production of bamboo arrows was their main income source (Table 1). The interviews included questions regarding the techniques used to collect the bamboo and to make bamboo arrows.

Table 1. Basic information of *yashi* interviewed in this study.

ID	Age	Area	Operation Type	No. of Generation	Source of Technique

A	40s	Akita	Family	3rd	Father
B	30s	Aichi	Limited Private Co.	7th	Father
C	70s	Fukuoka	Family	2nd	Father
D	70s	Ibaraki	Family	5th	Father
E	50s	Gunma	Limited Private Co.	3rd	Father

RESULTS AND DISCUSSION

Characteristics of Japanese Arrow Bamboo

The sizes of the arrows from various regions around the world are investigated. The size of Japanese bamboo arrow depends on the archer; the size is determined based on the length from the center of the throat to the tip of the finger plus 10–15 cm. Most Japanese bamboo arrows are around 1 m. From the survey, the average length of the arrows was 125.9 cm. Japanese bamboo arrows are slightly shorter than arrows used in other parts of the world, although the length of Japanese bows are longer in comparison. Most of arrows are made of bamboo or material from the *Poaceae* family. Only two examples from northern Japan and Canada were made of wood, with bamboo being the most commonly used material worldwide.

In Japan, the only bamboo species for used for bamboo arrows is Japanese arrow bamboo (*Pseudosasa japonica* var. *japonica*). However, in the past people did try other bamboo species of a similar size to Japanese arrow bamboo. In this study, six bamboo species were studied and measured as possible candidates for use for arrows. Our results showed that the height of node of the Japanese arrow bamboo was significantly smaller than that of other species (Fig. 1) (t-test, $P < 0.01$). The interviews also clarified that Japanese arrow bamboo was suitable for making arrows because the height of nodes are smaller than other species. While other characteristics are also important when making arrows, it is this characteristic upon which *yashi* base their selection of Japanese arrow bamboo. The other characteristics were not measured in this study and should be investigated in future research.

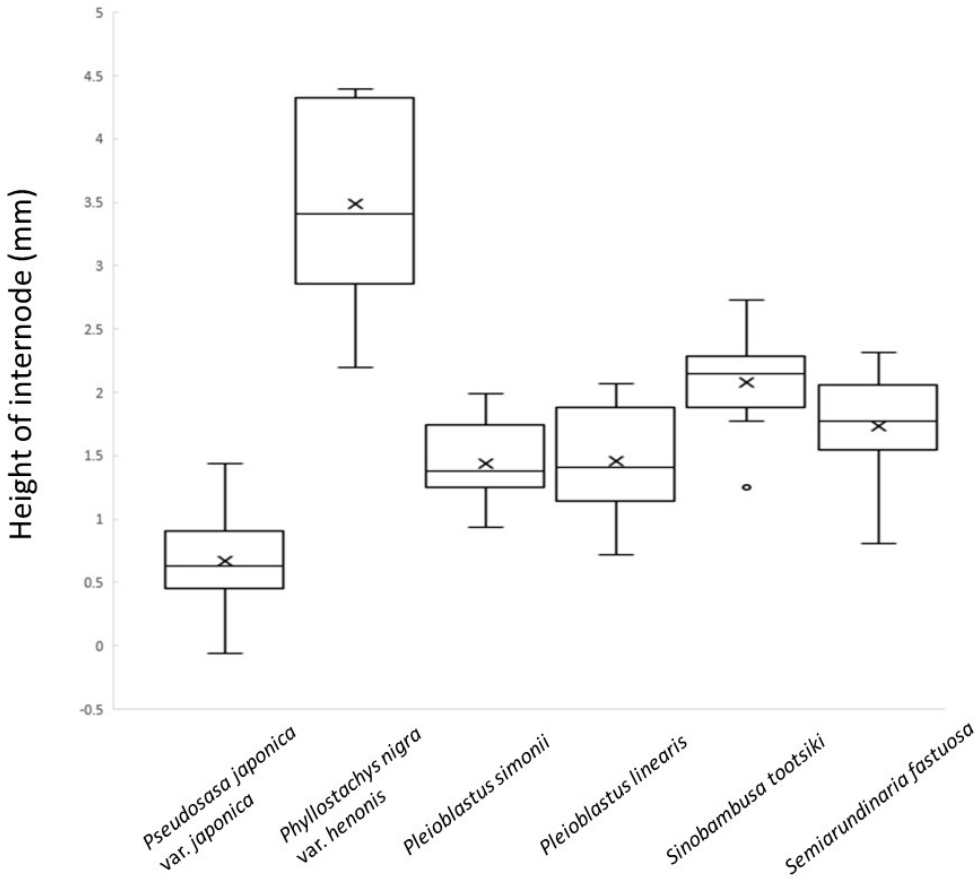

Figure 1. Height of internode of 6 bamboo species in Japan (*Phyllostachys nigra* var. *henonis*, *Pleioblastus simonii, Pleioblastus linearis, Pseudosasa japonica* var. *japonica, Sinobambusa tootsiki* and *Semiarundinaria fastuosa*).

Process of Producing Japanese Bamboo Arrows

We interviewed five *yashi* in this study, all from different prefectures. Despite living in different regions, they shared similar steps in producing bamboo arrows. Thus, we describe below the basic process used by *yashi* to produce Japanese bamboo arrows.

1. Harvesting, Drying and Sorting

Japanese arrow bamboo is harvested between late October and late December. Traditionally, the habitat of Japanese arrow bamboo was not managed and grew under natural conditions. Bamboo is harvested at 2–3 years of age; bamboo smaller than 10 mm in diameter is selected. The bamboo is cut from the node closest to the ground to around 1.5 m high. One week after the harvesting of the bamboo, the leaf sheath is removed. The harvested material is kept and dried until the following spring in a storehouse. The material is not treated at this time. This process is necessary because the bamboo will burst if it is not dry enough. After drying, the bamboo is sorted according to weight, diameter and the length of the internode. Bamboo arrows are typically sold in packs of four; thus, the sorting of the bamboo is an important step as a commercial product.

2. Rough Processing

The next step involves straightening the bamboo. *Yashi* use a simple bamboo tool called a *tamegi* (Fig. 2) and slowly scrape the tool along the bamboo. They then whittle the bamboo to adjust its weight, thickness and the center of mass. This step is an important, difficult and particularly sensitive step of the process. In the next step *yashi* sand the arrow. They sandwich the bamboo between two stones and repeatedly rub sand along the arrow while also dipping it in water.


Figure 2. *Tamegi.*

3. Processing

Yashi then place the bamboo into an oven (Fig. 3) to further straighten it. The arrow is done when it turns the color of chocolate; the bamboo is rotated to ensure an even coloring.


Figure 3. Oven to straighten Japanese arrow bamboo.

4. Washing and Polishing

The bamboo is then washed and polished using a plant (*Equisetum hyemale*). The other parts of the arrow are then attached including the tip, bird feathers and the parts to cleeking vine of the bow.

Characteristics of the Techniques to Produce Bamboo Arrows and Future Study

As described above, each step and the tools used to produce arrows are rather simple. In contrast, the skill level of the *yashi* is very high. Without such techniques and skills, *yashi* would be unable to produce sophisticated bamboo arrows. A single set of these bamboo arrows (four arrows) have been known to fetch US$10,000. Thus, this reflects the value of the special skills of *yashi*. In comparison to the skills required to make bamboo arrows, the management of Japanese arrow

bamboo forests is helpful but not critical for the production of bamboo arrows. The skills of *yashi* can likely overcome the differences among each individual piece of Japanese arrow bamboo (e.g., weight, moisture content, hardness, stickiness). For future study, it is necessary to clarify the various skills by analyzing the properties of Japanese bamboo arrows at each processing step. This will be important to clarify the differences of Japanese arrow bamboo under both wild and cultivated conditions from the viewpoint of domestication and to clarify the extent of the uniformity of bamboo arrows by the *yashis'* skills and techniques.

Our interviews with *yashi* revealed that they inherited the skills from their fathers, and not from any other relatives or teachers. The training period covers a long time, as they have to be taught many things from their father. This is one of challenges facing *yashi* if these expert craftsmen are to continue to produce high-quality bamboo arrows.

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LIST OF FIGURES

Diseño e Implementación de un Taller para Laminado en bambú.

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Periodo de Ejecución: 2016

I.Resumen:

El CIB – Perú, se gestó a través de un concurso en la Concytec – Cienciactiva y es financiado por el Fondo Nacional de Desarrollo Científico y Tecnológico (FONDECYT) y el Ministerio de Educación (MINEDU), se enfoca en dos proyectos: "Estudios etno-botánicos y potencial tecnológico de especies nativas y exóticas del bambú, en las regiones nor oriental y central del Perú" y "La cadena de valor del bambú hacia un modelo para el establecimiento de clústeres"

Este Proyecto, Tecnología con Bambú, forma parte del primer proyecto, y busca generar un impulso en la industrialización del recurso del bambú mediante la generación de productos, usando como materia prima el mismo, por lo que plantea la fabricación de laminados como producto piloto y que a su vez genere líneas de investigación para otros productos a base de este recurso poco explotado y estudiado.

El presente resumen tiene como finalidad mostrar el proceso del diseño, la instalación e implementación de máquinas y equipos para ensayos tecnológicos en laminado de bambú en un área que era destinada a ser un laboratorio de trabajabilidad y laminado de la madera.

Este taller es un piloto cuya objetivo es servir de base para futuras implementaciones, teniendo en cuenta el espacio que ocupa la máquina, el radio de acción de cada una de ellas, el espacio de interacción de cada investigador y medidas de seguridad en caso de desastres, es por ello que cuenta con planos de arquitectura, instalaciones eléctricas, seguridad, evacuación, plan de contingencias y emergencia y recomendaciones de mantenimiento preventivo de máquinas, los cuales están contenido en un manual[1].

El taller cuenta con un área de 70.12 m2. Las maquinas consideradas en el taller son: Sierra Radial, Ingleteadora Telescópica, Sierra Circular, Garlopa y Cepilladora.