Development of the bamboo sector in Ecuador: harnessing the potential of *Guadua angustifolia*

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Abstract—The bamboo species Guadua angustifolia has a long cultural tradition in the coastal lowlands of West Ecuador. Despite its excellent mechanical properties and versatility, it has mostly been used as a raw material for low-cost housing, while further product development has been very limited until now. In the last years, a *Guadua* revival seems to have occurred and improved building techniques together with other commercial applications are slowly getting momentum. This article analyses the actual development of the bamboo sector in Ecuador and its future perspectives, including the pitfalls and bottlenecks. The analysis is based on the experiences and observations of the authors as representatives of INBAR in Ecuador between the beginning of 2001 until the beginning of 2003 and their interviews with various stakeholders. The bamboo sector in Ecuador is still in the initial stage of development and the first investments in artisanal workshops and in industrial applications are now being developed. However, the production chain is hardly organized, the actors lack strategic planning and the activities in the different stages of the chain are not synchronized. The challenge is to link the processing industry to a rural supply system benefiting the impoverished part of the population. The management and primary processing of Guadua culms could become an important income source for Ecuador's rural poor, provided that they are supported in the acquirement of basic skills and the development of small enterprises. Moreover, planting Guadua has several environmental advantages and, thus, may offer a win-win scenario resulting in genuine sustainable development. This article tries to answer the question if Ecuador is on the right track towards such development and whether this trend stands on its own, or could be exemplary for other countries in South America with large bamboo resources.

Key words: Guadua angustifolia, bamboo sector development; sustainable development; poverty alleviation; Ecuador.

GUADUA ANGUSTIFOLIA

Guadua is a genus of tropical, clumping, thorny bamboo with approximately 30 species native to Colombia, Ecuador and Venezuela and introduced in various other

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Latin American and Caribbean countries. *Guadua* or caña Guadua is most abundant in the upper Cauca valley in Central Colombia and the pacific lowlands of Ecuador. Very little is known about its distribution and ecology, indeed its precise taxonomic classification is still uncertain. The economically most developed species, *Guadua angustifolia*, is characterised by large, erect, green culms that reach a height of 30 m and 20 cm in diameter [1]. The internodes are on average 26 cm long and a characteristic white coloured strip marks the nodes. During their flush of growth, the glossy green stalks are soft and lacking resistance and after 4 to 5 years they reach maturity. They are characterised by sporadic flowering and no mass flowering followed by death has been reported [2].

The most successful and cheapest way of reproduction has been developed in recent years in Colombia using vegetative reproduction of small plants (chusquines) sprouting at the rhizome of the bamboo as reaction to rapidly changing conditions, such as after intensive harvesting, high rainfall or fire [3]. These chusquines can be multiplied rapidly in nurseries at low costs and are ready for planting after 3 months.

GUADUA TRADITION IN ECUADOR AND COLOMBIA

Since pre-Colombian times, Guadua has been a widely used material for numerous applications in all the countries where it naturally occurred in South America. The Spanish conquistadors were amazed by its strength versatility and the Ecuador's largest city, Guayaquil, was built on Guadua houses until the beginning of the 20th century [4]. Guadua angustifolia has excellent physical and mechanical properties that make it one of the strongest existing bamboos and, thus, very suitable for constructions. In Ecuador, Guadua is the material for scaffolding and has innumerable uses at the farm level. In Colombia's coffee region, bamboo is still part of the local culture. Bridges, hillside houses of several stories tall, kitchen utensils, household objects, fences, stairways and drainage pipes are made of bamboo [5]. The construction industry is the largest consumer of Guadua poles in Colombia, consuming 70% of all Guadua, and poles are traditionally used to support floors, as scaffolding and formwork (casetonas), which saves much concrete and the need for reinforcement since much of the dead weight of concrete is avoided [6, 7]. The construction of upper-class Guadua houses has also flourished in the last decade due to the work of various architects of which Simon Velez is the most famous. Research and development of Guadua techniques and uses are much more developed in Colombia than in Ecuador, but examples of industrialised processing of Guadua are rare and there is no investment in a Guadua industry due to Colombia's civil war. For this reason, Ecuador benefits highly from importing Colombian experts in Guadua cultivation and construction technologies, while it has to pioneer in the industrialization of Guadua resources.

The actual lasting stands of *Guadua* in Ecuador are rapidly disappearing due to uncontrolled cutting and conversion of forested land into arable land. An inventory in 1985 reported 15 000 ha of small dispersed stands in the coastal provinces, while

estimates in 1999 counted around 6000 to 9000 ha [4, 8]. In Colombia natural stands have also been cleared and an estimated 60 000 ha is remaining from the hundreds of thousands that covered Colombia's central coffee region centuries ago before it was colonized (L. F. Botero, personal communication). This depredation is a consequence of the attitude of the large majority of the farmers and landowners who consider *Guadua* as a weed that occupies fertile patches of land and needs to be eliminated. Its economic value only appears when an intermediary offers the landowner some dollars in order to be able to clear-cut the unmanaged stand.

Unprocessed bamboo is used for rural constructions, urban houses in Ecuador's coastal slums and a variety of other domestic uses. The use of *Guadua* for furniture making and small handicrafts is limited to the Pacific coast, where local artisans and small workshops offer low-quality products. A small amount of the used bamboo is preserved using traditional preservation methods such as water immersion and vertical drying in the forest. These methods are effective in reducing the sugar and starch content, but do not guarantee a full protection in Ecuador's hot and humid climate and, consequently, most low-cost bamboo constructions and utensils suffer from humidity, insect attacks and fungi and need replacement after 3–4 years of use. Recently, adequate preservation methods are slowly seeping through. Traditionally most of the processing and trading of *Guadua* happens in an informal market. However, with the recently emerging bamboo processing industry a more formal market structure is due to develop.

GUADUA'S ECONOMIC POTENTIAL

Cultivated and exploited on a sustained-yield basis, Guadua bamboo provides commercial culms after 4-5 years, regenerates naturally and yields annually up to 1300 mature poles per hectare. In general one can say that a mature pole with an average of 18 m has, under current market conditions in Ecuador, a farm-gate price of approximately 1.30 US \$. (On average a mature Guadua pole can be commercialised as two pieces of 6 m each with a farm gate value of approx. US \$ 0.50 and a top that is used as banana prop with a farm gate value of US \$ 0.30 [9].) While the total investment cost for the establishment and maintenance of a Guadua plantation amounts to US \$ 1500/ha for the first three unproductive years of a plantation, the years thereafter it yields an average annual income of US \$ 1690/ha with maintenance and harvesting costs of only US \$ 300/ha per/year. (Investment costs rise to US \$ 680/ha in year 1 for establishing the plantation, during the first 3 years a maximum of US \$ 900/ha is spend on maintenance and fertilisation [9].) Although it remains difficult to predict market conditions and prices of a new emerging market in five years time, these figures show potentially interesting benefits, especially because of the annual natural regeneration of the bamboo guaranteeing a constant production based on one time establishment costs. In addition, it is an interesting multifunctional crop and a good diversification

alternative for small and intermediate producers of traditional cash crops such as banana and coffee, who can hardly compete in national and international markets.

Guadua planting could become particularly interesting for poor farmers in Ecuador's coastal area. The majority of the farmers has sufficient land available and if they can organize the propagation of the seedlings in community nurseries, they can reduce direct investment costs considerably and obtain a low-risk crop that yields cash every year. However, at this moment farmers do not manage the small natural stands left standing on their land and prefer short-term benefits. They are not aware of the potential of the product and are subject to exploitative marketing arrangements dominated by wholesalers who have an oligopsonistic market position. (Due to the underdeveloped market for *Guadua* poles a few buyers exert a disproportionate influence on the market and keep prices low.) Farmers sell the standing culms for a stumpage value of US \$ 0.20 to intermediaries, who clear-cut the entire stand, resulting in the destruction of the clump's regenerative capacity. Major obstacles to alter this destructive mechanism are a lack of knowledge and market information, lack of investment capital for proper management and commercialisation, and the poverty level of the rural people requiring instant cash.

Meanwhile, the demand for bamboo poles is growing, resulting in an increased pressure on the resources. The largest part of the trade of *Guadua angustifolia* in Ecuador has an informal character without regulations, permits and, therefore, does not show up in Ecuador's official economic figures. That is also the case for Ecuador's largest export market, Peru, which consumes for construction purposes a reportedly 1 million *Guadua* poles per year with a value of US \$ 2 million according to insiders of the informal trade. In contrast, Ecuador's official export figures only show an export value of US \$ 40 000 per year [9]. The ongoing depletion of natural stands will one day or another end in serious supply problems for this informal market which is supplying many sectors with a valuable raw material.

The banana industry, with around 150 000 ha of plantations in the coastal region, is one of the major users of bamboo in the country, applying the upper part of the pole for supporting the banana bunches. At this moment, the majority of the banana producers uses polyethylene rope to support bunches, but bamboo props are becoming more popular due to the lower labour costs per hectare and the environmental requirements of green certificates that prefer bamboo, which decomposes much more rapidly than the used rope. Several bamboo species are used for banana props (Guadua angustifolia, Guadua paniculata and Bambusa vulgaris), with Guadua as the most resistant and durable. Replacing all rope by *Guadua* props would require approximately 75 million props annually (500 props/ha per year), which would represent the annual prop harvest of around 70000 ha of Guadua plantations in full production [10]. If the trend of converting rope to Guadua poles gains momentum, it will be particularly interesting for smallholders who can supply props that do not require high-quality poles, large diameters or sophisticated processing. The banana industry may then become the largest market outlet for Guadua in the near future.

WAITING FOR THE 'BAMBOO BOOM'

In addition to an increased demand for traditional purposes, several large investors opt for more sophisticated applications, with China's multimillion flooring, panel and furniture industry as shining example. As a result Ecuador's bamboo development is at this moment in a stage of speculative planting. Since 2001, a few agro-industrial consortia are planting large extensions of Guadua and a number of private landowners are planting on a smaller scale, totalling approximately 1000 ha per year. The first 1000 ha planted will become harvestable in 2005 (M. Cedeño, personal communication). Not surprisingly, commercial activity is today situated in the propagation and planting business and as much as 20 commercial nurseries have popped up selling *Guadua* seedlings. The large majority of the landowners are planting Guadua without thorough cost-benefit analyses, market information or business plans and just speculate that a 'bamboo boom' will take off once their plantations start producing. Several agro-industrial consortia have the ambition to establish processing factories, but for the moment, the only example of industrialised Guadua processing in Ecuador is a flooring factory near Guayaquil that produces Guadua flooring for the national market and plans to export in the coming years when its products are able to meet international quality standards [11].

This actual situation raises the question whether the Guadua development in Ecuador is just a speculative planting hype or a promising crop that will supply the raw material for a new export industry of *Guadua* products. Objective criteria to predict this are not yet available. CORPEI (Ecuador's institute for export promotion) and the Ministry of Agriculture have declared bamboo as one of the 10 promising export products that Ecuador should develop in the coming years [9, 12]. However, this projection is not based on accurate market research or official and consistent data on bamboo consumption. The official figures underestimate the export of unprocessed Guadua poles to Peru and very probably overestimate the potential of Guadua flooring and poles for decoration and construction in the allegedly large markets in the USA and Europe. A second critical point is Ecuador's relatively high production costs. The combination of its unabated high inflation (more than 10% per year) and its dollarized economy make it hard for Ecuadorian products to compete with cheap Asian bamboo products with an established market share in the US and Europe. Hopefully a detailed national and international market study to be performed in 2003 by CORPEI in cooperation with the CBI (a Dutch centre for promotion of import from developing countries) will result in realistic figures on the market potential and a sound national development strategy for the bamboo sector.

Notwithstanding, the planting boom is crucial and a blessing for the future development of Ecuador's bamboo sector if it plans to produce industrialised products for a potential export market. From 2005 onward, an estimated 1000 ha of mature *Guadua* can be harvested each year, provided that the present pace of planting continues, and this can supply a standardised source of raw material, which is the necessary condition for whatever kind of industrialisation stage.

BAMBOO AS POOR MAN'S TIMBER

Other crucial conditions for the sector's sustainable development are increased awareness raising on the potentials of bamboo combined with education and training of bamboo experts in different fields. More than in Colombia, bamboo in Ecuador continues to be stigmatised as a low-class, low-value material associated with poverty and marginality. Bamboo has always been a cheap and easily available material in Ecuador's lowlands and can be transformed without much labour in simple uses and utensils. It is the favourite material from which traditional rural houses are built and in the shantytowns of major coastal cities flattened bamboo (caña picada) is used to cover walls of timber frame houses roofed with corrugated iron. Occupants consider it as temporary shelters, designed to last until the resources are acquired to replace them with cement blocks [13]. However, due to a severe economic crisis at the end of the 1990s, that even more widened the gap between rich and poor, most people in the slums have been obliged to consider their bamboo shacks as permanent houses. (Today 79% of the Ecuadorians lives below the national poverty line, and 49% are under the indigence line [14]. GDP has recovered after the economy has been dollarised in 1999, but inflation remains high and the economic revival has favoured only the happy few.)

The largest single buyer of Guadua for construction is Viviendas Hogar de Cristo (VHC), a Christian NGO based in Guayaquil that manufactures low-cost houses made of wood and bamboo. VHC produces panels that people assemble through a self-help construction, which is both an extremely rapid construct (1 day) and very cheap (US \$ 450). Hogar de Cristo supplies 70 houses per working day to the poorest of the poor, requiring more than 300 000 flattened bamboos of 6 m long per annum [15] (Hogar de Cristo, data not shown). Apparently, this amount is not enough to offer a house to all the people who line up daily in front of VHC's factory. The accumulated housing deficit in Guayaquil with its 2.5 million inhabitants is more than 100000 houses and continues to grow with 12000 units annually due a continuous rural-urban migration [16]. Problem is that VHC requires flattened Guadua at the lowest cost to keep the price of the house down and, thus, is inclined to buy low-quality Guadua and apply it without using any further preservation method in its wall panels. This low-quality bamboo material often originates from immature poles, which are not harvested from sustainably managed bamboo stands. For this reason several public and private organizations and experts keep searching more sustainable and durable, but cheap alternatives, proposing a better selection of raw material and preservation methods, and designing more durable houses. The interest for bamboo as durable and higher value building material is rising among Ecuadorian architects and engineers, largely inspired by Colombian Guadua architecture and the esthetical and sustainable features demonstrated by various incountry bamboo construction projects.

ECUADOR'S BAMBOO SECTOR DEVELOPMENT

Next to the existing markets for *Guadua* in the sectors of construction and banana props, niche markets exist for *Guadua* handicrafts, furniture and industrialized products. *Guadua* flooring and perhaps *Guadua* panels are indeed most interesting for a large industrial development of the sector. These industrial development lines have the potential of developing high-quality *Guadua* products and can generate considerable added value and jobs when the production will rise. Also the export of properly preserved semi-processed *Guadua* poles for construction and decoration in the USA and Europe could become interesting. It needs to be promoted as an alternative for wood and take advantage of its green image as part of an international information and promotion campaign and CORPEI's actual efforts are promising and a step in the right direction. Moreover, Ecuador needs to take the challenge not only to copy Asian bamboo products, but to develop its own designs and concepts based on the characteristics of *Guadua* bamboo and its own cultural background.

The recent planting rate of 1000 ha of *Guadua* per year and the absence of further development of processing plants holds the risk that the early birds will catch the worms and that the others who are planting today and have to wait 4 years for their *Guadua* to mature, enter a saturated market characterised by a large supply of unprocessed *Guadua* poles and little new demand. This will inevitably result in falling prices and the duration of that situation will depend on governmental policies that actively start to promote industrial applications for *Guadua* and, thus, create conditions for the development of a large processing industry. A first and important step in this direction is the recent formation of a National Bamboo Consultation Commission aiming at the formulation and creation of adequate strategies and conditions for development of the sector and involving representatives of several ministries, NGOs and of different interest groups from the private sector.

At this moment, only a few corporations possess financial means and expertise to cultivate *Guadua* on an industrial scale and develop a processing industry for industrialised bamboo applications. However, it is highly unlikely that they will instigate the development of a bamboo sector at the farm level, because most firms seek vertical integration of the production chain and plan to grow enough *Guadua* to supply their required raw material. Therefore, it is likely that, unless other strategies are developed, a small business elite will profit most from the development of an industrial bamboo sector and that the full potential of bamboo will forego the mass of the poor.

An alternative, offered by several NGOs working in rural development, is a community-based development of the bamboo sector that will directly channel the benefits of the commercialisation and the added value of processed *Guadua* poles to the household level. This strategy requires a conversion of the actual system dominated by wholesalers who clear-cut at low stumpage values to the controlled management of natural stands and commercialisation by farmers organized at the communal level. Actual bottlenecks are the low organisational level, the lack of credit and the absence of governmental support. A number of NGOs,

together with INBAR, are establishing pilot projects with communal nurseries and imparting knowledge to farmers about management, cultivation and processing. The most successful initiative until now has been a UNDP-sponsored micro-project that has established *Guadua* nurseries, reforested eroded riverbanks and organised workshops on bamboo management and processing into handicrafts and furniture. A positive development is that national and international donors gradually become convinced about the potential of such projects.

The ideal situation for sustainable development would be a synergy between both levels of bamboo development, resembling China's integrated production chain, with smallholders taking care of planting bamboo and supplying the processing industry with semi-processed poles, laths and mats. This combination of the farm level and the industrial sector would be a sake for the ailing national economy and a new opportunity for the rural poor. It requires the formulation of a national strategy for development of the bamboo sector, involving a rural production and management plan, a training and education component and a processing and industrialization strategy tuned in at national and international markets and supported by national policies. For the sake of sustainable rural development this should include a massive rural development plan that starts with awareness-building regarding the potential of *Guadua* and can count on governmental support and credit lines to train and support small farmers, who lack the knowledge to properly plant, manage and process *Guadua* poles.

BAMBOO AND THE COMPETITION WITH THE WOOD SECTOR

An important external constraint in the development of Ecuador's bamboo sector is the availability of cheap wood from unmanaged natural forests. *Guadua* could provide a sustainable alternative for many wood applications in the building and decoration sector. However, to date wood is by far the easiest and most convenient construction material in Ecuador and there is still plenty of timber available, resulting in relatively low timber prices. The wood industry is able to clear trees in natural forests in the Northern province of Esmeraldas and in Ecuador's Amazon region without paying appropriate taxes or proper regulations. The fact is that there is too much forest and timber still left in Ecuador, so that there is not really a need to substitute with bamboo today, a need that on the other hand made the Chinese bamboo sector flourish. However, in the course of the following 10–20 years the last natural forests will be cleared or situated in remote areas, causing the need for a rapidly regenerating woody resource close to Ecuador's economic centre Guayaquil. So, *Guadua* has time on its side, but needs to change its poor image in order to compete with timber.

Guadua has also to win a legal battle with wood because, according to the forestry law, all natural stands of *Guadua* are considered a forest product susceptible to the same reforestation taxes and requirements as regular wood. However, in contrast to wood bamboo does not need replanting, grows much more rapidly and needs to be

exploited in order to reach optimal production. The creation of the National Bamboo Consultation Commission is an important step forward and may prevent further policy contradictions and bottlenecks. The Ministry of Environment is slowly becoming aware of the value of natural *Guadua* stands for environmental protection, with their sympodial rhizome structure for soil protection, erosion control, and watershed management. The ministry's next step in the formalization process might be to issue a national *Guadua* management regulation. At the same time, the Ministry of Agriculture has started perceiving bamboo as an interesting agricultural cash crop, which should be managed and regulated under their jurisdiction.

CONCLUSIONS

The development of the bamboo sector is experiencing growing interest in Ecuador's coastal region and is mainly focused on the endemic species Guadua angustifolia. This tall and strong bamboo species is gradually loosing its stigma of a poor and temporal construction material and becoming a crop, lucrative to plant and raw material to a range of products. Actual bamboo use is still mainly situated in the low-cost construction sector and in the banana industry for supporting bunches; both requiring only unprocessed and untreated bamboo without much added value. However, more luxury and durable architectural projects are implemented, a growing number of small furniture and handicraft workshops are set up, and the first industrial applications are now being developed. At the same time several public agencies and NGOs seek incorporation of bamboo-based activities in their development programmes, including production and processing of bamboo and low-cost housing projects. These initiatives are promising due to the excellent physical and mechanical characteristics of Guadua, which make it a versatile bamboo for many applications. However, to be successful, these initiatives have to come together with proper strategic planning and adequate handling of bamboo as a raw material for architectural and industrial applications.

For the moment, Ecuador's bamboo development consists of speculative planting and a substantial and standardized source of raw material from plantations becomes only available in the next five years. There is still a long way to go and the lack of adequate policy measures, skilled labour force and credit facilities hamper the development of the sector. Once these major political, organisational and businesslike bottlenecks have been cleared, bamboo can create opportunities for large investors and poor smallholders with natural *Guadua* stands on their land. The ideal match will be a symbiotic linkage between small-scale bamboo producers and large processing enterprises providing smallholders with a sustainable income source and supplying the industry with raw material for industrial high-quality export products. Such synergy, however, requires ample assistance of public and private institutions, the implementation of bamboo research and development programs, and the validation and outreach of adequate information and technologies. Such exchange of technologies needs to be organised at a regional level in order to benefit other countries in the region. All of Ecuador's neighbouring countries have large bamboo resources and can learn from Ecuador's experiences with integrated community projects and (semi-industrial) processing plants. Although Colombia is a decade ahead when it comes to cherishing its *Guadua* culture, managing its resources and using it for construction, industrialisation is lagging behind. Other countries such as Brazil, Cuba, Costa Rica and Bolivia are interested in developing their bamboo sector, but so far lack the required expertise, access to resources and/or institutional support.

It will depend on further macro-economic conditions, proper political incentives and adequate technical guidance by expert organizations to make the Ecuadorian bamboo sector flourishing, setting an example for other countries in Latin America.

REFERENCES

- 1. E. Judziewicz, L.G. Clark, X. Londoño and M. Stern, *American Bamboos*. Smithsonian Institution, Washington, DC (1999).
- 2. C. Kirkby, The distribution, abundance, clump characteristics and techniques for managing *Guadua cf. angustifolia*, Bambuseae, a potential non-wood forest product, in: Madre de Dios, Peru, http://www.geocities.com/marona_mdd/ (2001).
- 3. E. Giraldo Herrera and A. Sabogal Ospina, *La Guadua, una Alternativa Sostenible*. Corporación Autonoma Regional del Quindio, Colombia (1999) (in Spanish).
- 4. J. Moran Ubidia, Traditional and current uses of bamboo in Latin America with emphasis on Colombia and Ecuador, Escuela Politecnica litoral, Comunic Art, Quito (2001).
- 5. B. Villegas, Bambusa *Guadua*. Villegas, Bogotá (1989) (in Spanish; English edition by Rizzoli, New York).
- 6. A. Colorado, La Guadua, Una Maravilla Natural de Grandes Bondades y Promisorio Futuro, Revista el Mueble y la Madera, http://www.revista-mm.com/rev34/Guadua.htm (2001) (in Spanish).
- 7. J. J. A. Janssen, Designing and Building with Bamboo, in: *INBAR Technical Report* 20, p. 208. INBAR, Beijing (2000).
- 8. J. J. Parsons, Giant American bamboo in the vernacular architecture of Colombia and Ecuador, *Geogr. Rev.* **81**, 131 (1991).
- 9. CORPEI, Perfil de Producto de Caña Brava, Proyecto CORPEI-CBI, expansión de la oferta exportable del Ecuador (2002).
- 10. Quelal, Necesidad de Guadua en la agroindustria bananera Ecuatoriana, presentation at the International Bamboo Congress, Guayaquil (2001).
- 11. HARDBOO webpage: http://www.tropicalhardboo.com(2002).
- 12. MAG webpage: http://www.sica.gov.ec/agronegocios/ (2002).
- 13. A. Gutierrez, Structural Adequacy of Traditional bamboo Housing in Latin America, *INBAR Technical Report 19*, INBAR, Beijing (2000).
- 14. UNDP, Informe sobre desarrollo humano Ecuador (2001), http://www.undp.org.ec/Idh2001/ Informe.php (2001).
- 15. Hogar de Cristo webpage: http://www.vhc.org.ec/html/pag2.html (2002).
- 16. D. Diacon, *Housing the Homeless in Ecuador, Affordable Housing for the Poorest of the Poor.* Building and Social Housing Foundation, Leisester (1998).

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