Bamboo Shoots as Food Sources in the Philippines: Status and Constraints in Production and Utilization

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Abstract

Bamboo biodiversity and conservation in these times of natural and man-made disasters and calamities is very important. The dwindling number of bamboo species in the forests and natural waterways is already unabated. This is coupled with increasing human population that not only continues to contribute to pollution of the environment, but also extract resources, thus natural bamboo groves are disappearing. Because of this, use of bamboo shoots as food source is limited especially where there are no more bamboo stands. This is also the result of its status as a poor man's timber and a minor forest and natural resource in the past decades. This paper generally aims to disseminate the "back to basics" importance of bamboo and bamboo shoots, campaign for its continued planting and advocate for better appreciation of its use as food especially to a generation that has been alienated from traditional food items. Genetic conservation for this crop species is being promoted not only for food and wellness but also for its vital role in the environment. It specifically presents the status and prospect of bamboo shoots as potential food source in the Philippines. Some unpublished data and observations on shoot characteristics and plantation establishment of some local bamboo species are also presented as well as the economic benefits of bamboo shoot farming based on previous studies. Problems in bamboo shoot R&D, constraints in production and utilization are also enumerated. The paper also encouraged the continuous and reinvigorated use of bamboo shoots as food source in the Philippines. The current prospects of bamboo initiatives are also discussed. With the above aims, bamboo will be the renewable resource in this most vulnerable time of climate change.

Introduction

Bamboo, with its thousand uses, is now becoming more popular in the Philippines especially for multiple benefits for humans and the environment. Popularly known before as the "poor man's timber", it is now hailed as the 'climate change grass' and retaining its famous descriptive line "the tallest grass of life". Stands of bamboos are everywhere in the country, the Philippines being endowed with many native (including endemic) bamboo species that are naturally growing in different habitats. Several species have also been introduced and are now acclimated or well adapted to local conditions.

However, the natural stands of bamboo have dwindled and so have the bamboo shoots. With the onslaught of natural and man-made calamities especially soil erosion and flooding, the acreage of bamboo had significantly decreased in the whole archipelago in the last centuries. As a consequence, bamboo shoots for food has also decreased. Recent findings also showed that this underutilized food source is also unpopular to the new generation of Filipinos, who have been more accustomed to Western cuisine, often less healthy, fast food style. With this scenario, there is a great challenge to educate our young people to patronize the use of bamboo shoot as food.

Bamboo shoots from all bamboo species can be used as vegetable shoots. From the shoots of the giant bamboo (*Dendrocalamus asper*) which can feed the whole of the barrio folks to the thin shoots of anos (*Schizostachyum lima*) which is asparagus-like and can be used as ingredients for any delicacy. Popularly known as "labong" in Southern Tagalog and the Bicol region, "rabung" in the Ilocandia and northern regions, "dabung" in Cebu and mostly in the Visayas and Mindanao provinces. or "tambo" in Iloilo and other regions, and many other names by indigenous people (hubwal, harepeng, uvug, etc.) are evidence that bamboo shoots are widely used as food for most Filipinos. "Dinengdeng", "lumpia", "paklay", "ginataan", "adobo", "atsara", "kilawen", "chopsuey", and many more commonly cooked recipes can have bamboo shoots as the main ingredients (Caasi-Lit 1999).

As the tree of life, the longest and fastest growing grass species, an emblem of longevity, resilience and endurance, bamboo shoots are highly valued as food in China and Japan and other Asian countries. Bamboo shoots are very nutritious, an organic, renewable and sustainable resource, the health food of the modern century. Researches on bamboo shoots and reviews were also conducted specifically on the survey of bamboo shoot resources in the Philippines and the cyanide content of several bamboo species with quality shoots (Caasi-Lit et al. 2010a; Caasi-Lit et al. 2010b). References for the basic aspect of the bamboo shoot are those of Santos (1986), Dransfield and Widjaja (1995), Rojo et al. (2000) and Virtucio & Roxas (2003).

However, only few studies have been done for bamboo shoot research and development (R&D) under Philippine conditions. Most of the work focused on culm propagation, production, harvesting and marketing. As such, with the lack of basic information on shoot characteristics, it will be difficult to formulate a business venture on bamboo shoot production. The lack of funds for basic research on bamboo shoots is also a major reason for the lack of baseline information.

With the recent awareness of the importance of the environment, bamboo is now an emerging and very promising commodity. This is demonstrated by the banner program of the government for bamboo reforestation targeting 500,000 hectares as its contribution to ASEAN commitment of 20 million hectares of new forest by 2020. Bamboo can be the anchor renewable resource that can be tapped for commercial production, community livelihood and environmental protection initiatives.

This paper aims to: 1) assess the status and prospects of bamboo shoots as potential food source or as vegetable in the Philippines; 2) enumerate the problems in bamboo shoot R&D and constraints in production and utilization; 3) present some unpublished data and observations on shoot characteristics and plantation establishment of some local bamboo species; and 4) document the economic benefits of bamboo shoot farming based on previous studies and promote the continuous use of bamboo shoots as food source in the Philippines.

Status of Bamboo Shoots as Food

In the Philippines, bamboo shoots are underutilized as food sources. The supply remains very limited especially during the dry season. In a survey conducted in late 1990s, there was a lack of information on the importance of bamboo shoots as food especially among the young generation and on the aspect of bamboo shoot research and development (Caasi-Lit 1999, 2000). Deforestation and land conversion had limited the supply of bamboo shoots in the local market. However, due to increasing human population that not only continues to contribute to pollution of the environment, but also extract resources, the natural bamboo groves are disappearing. Flooding, landslides and other natural calamities also contributed to the limited supply of bamboo shoots.

An estimate by the Bureau of Agricultural Statistics in 2002-2007 showed an annual average of 7,722 ha of bamboo was harvested for bamboo shoots (BAS 2007). Supply of bamboo shoots in the local

market in different provinces are mostly from fresh whole bamboo shoot, sliced fresh shoots, and cooked sliced shoots. Canned bamboo shoots from China and Japan are available in the supermarkets and most food stores in the business district of Divisoria, Metro Manila. As of this writing, all bamboo shoots are manually processed and there is no available factory for bamboo shoot processing. Canned bamboo shoots and other bamboo shoot products are mostly traded from China.

Bamboo Species Commonly Used as Food Source

As mentioned in our previous studies, all bamboo species can be used as food as long as the cyanide content is removed or diminished. In the Philippines, the most common species of bamboo for food are enumerated by Batugal (1975), Caasi-Lit (1999); Virtucio and Roxas (2003), Caasi-Lit et al. (2010). The most common species listed in Table 1 are the spiny bamboo or "Kawayang tinik" or (*Bambusa blumeana*), Bayog (*Bambusa merrilliana*), Laak (*Bambusa philippinensis*), Common bamboo or "Kiling" (*Bambusa vulgaris* var. *vulgaris*), Giant bamboo (*Dendrocalamus asper*), Machiku (*Dendrocalamus latiflorus*), "Kayali" (*Gigantochloa atter*), Bolo (*Gigantochloa levis*). Bayog and Laak are the two endemic species in the country. Bayog is found in almost all parts of the country with the original samples taken from Palo, Leyte. Laak is abundant in Mindanao and was originally found only in Mati, Davao Oriental. Based on the survey in 1999-2000, the most predominant local bamboo species in different parts of the country was *B. blumeana* followed by *B. vulgaris*.

Comparison of Young Shoots

Only the young shoots of seven local species (*B. merrilliana* and *B. philippinensis*) are qualitatively described below (Fig. 1-7). A preliminary study on the detailed morphological characteristics of young shoots of some local bamboo species for identification is presented in a separate paper by Ricohermoso et al. (2014).

B. blumeana (Fig. 1a & b). The shoots are light grayish green and smooth with few trichomes on leaf sheaths. The blades are appressed from base to tip.

B. merrilliana (Fig. 1c & d). Almost similar to *B. blumeana* except for the blade posture being appressed at the base and middle and reflexed toward the tip.

B. philippinensis (Fig. 2a & b). Young shoots are light green and largely covered with thick black trichomes. The blades are enlarged from the neck especially extending the whole structure at the tip of the shoots

G. atter (Fig. 2c & d). Young shoots are light orange brown and covered with thick light grayish trichomes (tufted). The blades are relatively extended and reflexed and get enlarged at the apex of the shoots.

G. levis (Fig. 3a & b). Young shoots are brick brown and almost similar to *G. atter* except that the culm sheaths are covered with very thick hairs. The blades are extended and reflexed and enlarged towards the apex.

D. asper (Fig. 3c). The shoots of the giant bamboo are light grayish light brown with dull purple outline of the culm sheaths. The blades generally resemble that of the genera *Gigantochloa*. The blades are reflexed from the base to the tip of the shoots.

D. latiflorus (Fig. 4a & b). The shoots are light green, smooth with very fine unnoticeable hairs. The culm sheaths do not have a marked outline like *D. asper* but with only fine outline and light yellow patches. The blades are reflexed from the base to the tip.

Exterior and interior sections of the young shoots

Figure 5 shows the external features of fresh whole young shoots (a) and the peeled fresh shoots (b) of the different local bamboo species. The exterior appearance of bamboo shoots can already serve as a guide to identify the different species of bamboo. This is through the color of the young shoots, the nature of the culm sheaths with the distinct blade at the apex. The blade is the most prominent identifying mark. All of the shoots are generally shaped like a pyramid, stupa, pagoda, cone, bell or polygon and variation of the sizes at the base middle and tip of the shoot.

Peeled fresh shoots are also shaped like pyramid or pagoda (Fig. 5). The shape of the peeled shoots of *Bambusa* are like the dome-shaped top of churches that tapers at the tip. The shoots of *Gigantochloa* spp are acutely conical with distinct pointed tip. The shape of the shoots of *Dendrocalamus* spp are like the Aztec pyramids in Mexico heavy and solid at the base with the prominent sharp tip.

When cut longitudinally, the interior of the shoots is hollow showing the tapering hollow portion (internode) and the filled layers or solid plates (nodes) as shown in Fig. 6 and Fig. 7. The interior of most *Bambusa* species (Laak and Kiling) have tapering solid layers and thick culms while the *Gigantochloa* spp. have two layers, the thin upper layer and the thicker lower layer (Fig. 6). On the other hand, young shoots of *Dendrocalamus* spp. have solid and almost without the characteristic hollow at the central portion of the shoots (Fig. 7).

Fig. 1 (a, b, c & d).

Fig. 2 (a, b, c & d)

Theme: Food and Pharmaceuticals

Fig. 3 (a, b, & c)

Fig 4. (a & b).

Fig. 5 (a & b)

Theme: Food and Pharmaceuticals

Table 1. Commonly used species of locally grown bamboo as food source in the Philippines (modified from Caasi-Lit 1999).

Scientific name	Common name	Tagalog/Filipino	Other languages
Commonly used			
Bambusa blumeana	Spiny bamboo	Kawayang tinik	Siitan (Ilocano); Batakan, Tunukon (Bisaya); Dugian, Kabugauan, Marurugi, Rugian (Bikol)
Bambusa merrilliana	None	Bayog	
Bambusa philippinensis		Laak	
Bambusa vulgaris	Common bamboo	Kiling, Taring, Tewanak	Tiling, Limas (Panay); Sinamgang (Cebu); Maribal (Bikol)
Dendrocalamus asper	Giant bamboo	Giant bolo	Botong (Bikol); Butong (Bisaya); Patong (Bisaya)
Dendrocalamus latiflorus	Machiku		Buntong (Cebu); Botong (Davao)
Gigantochloa atter		Kayali	
Gigantochloa levis	Poring bamboo; smooth-shoot gigantochloa	Bolo, Kawayan tsina, Bongsina, Buhong-china	Bolo, Botong (Panay); Buton (Cebu); Kabolian, Patong (Bikol)
Not commonly used			
Cephalostachyum mindorense		Bagto	Bagtok, Bikal (Bikol)
Dinochloa luconiae		Osiu, Timak, Usiu	Bika, Bikal (Ibanag); Bolokaui (Bisaya); Malilit (Sambali)
Dinochloa pubiramea			Bukao (Yakan)
Schizostachyum lima		Anos	Bagakai (Bisaya; Bikol); Sumibiling (Tagbanua); Bitu (Pampangan); Lakap (Bukidnon); nao-nap (Cebu)
Schizostachyum lumampao		Buho, Lumampao	Bagakan (Bisaya)

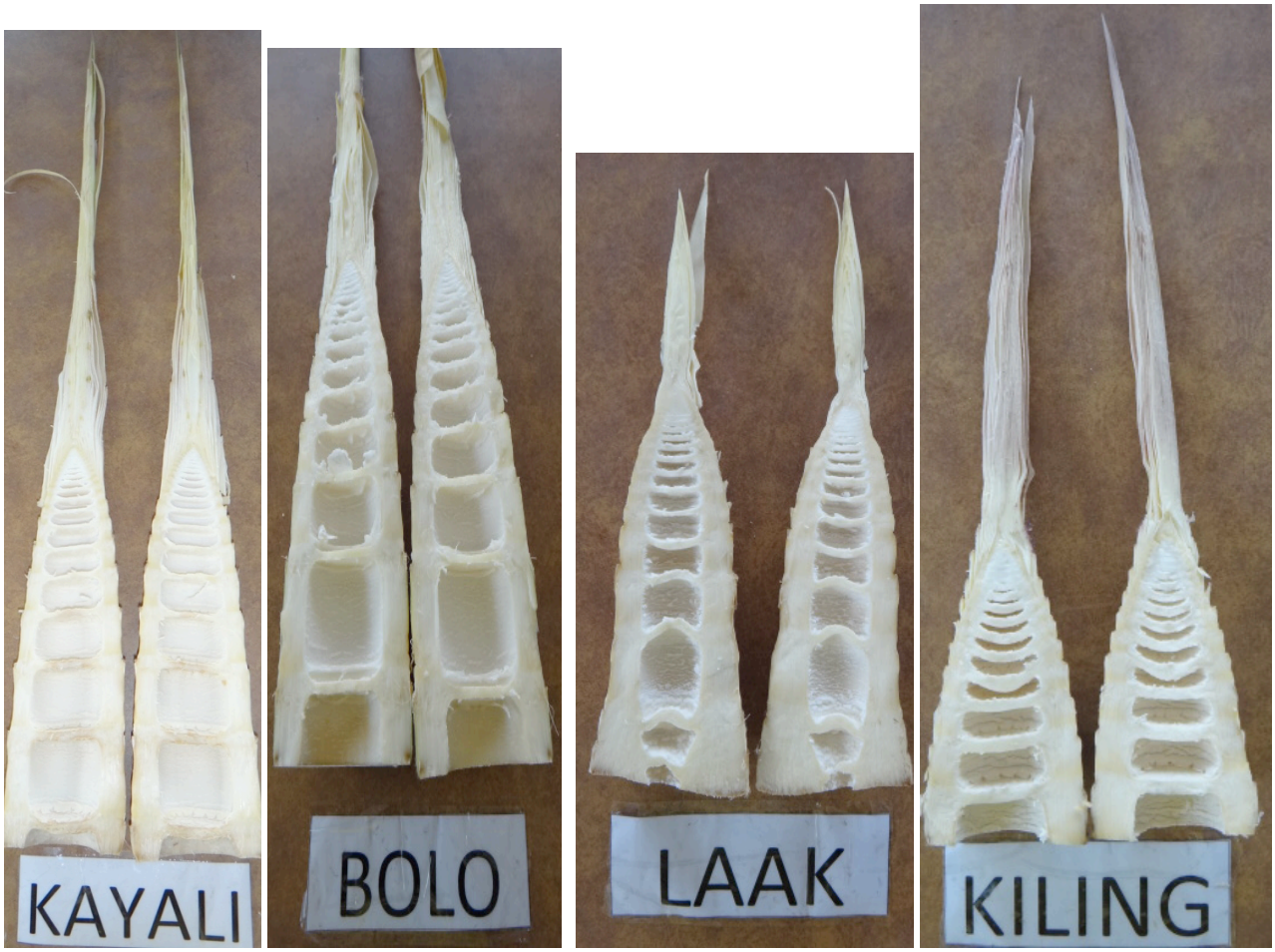

Fig. 6 (a, b, c, & d).

Fig. 7 (a & b).

Theme: Food and Pharmaceuticals

Cyanide content of local bamboo species

The bitter chemical of fresh bamboo shoots is called hydrocyanic acid or cyanide (CN). Cyanide occurs widely in nature and it is even present in human blood at low concentrations (Montgomery 1980). Among bamboos as in many other grasses and plants, they are released from cyanogenic glucosides in plant tissues, which have evolved as mechanisms to counter herbivore attacks. However, high concentration of cyanide is lethal to humans. Oral lethal dose for humans ranges from 0.5-3.5 mg/kg body weight (Bradbury and Holloway 1998).

Gonzalez and Apostol in 1968 reported the chemical properties and eating qualities of some local bamboo species. Their study showed that *B. blumeana* was most preferred for eating. In the study of Batugal (1975), the young shoots of some uncommon local bamboo species were also edible such as Anos, Bagto, Bagakan and Kalbang. In 1995, studies from the Ecosystem Research Development Bureau of the Department of Environment and Natural Resources listed three bamboo species which were primarily utilized as shoots namely Bayog (earlier identified as *B. blumeana* var. *luzonensis*), Kawayang tinik (*B. blumeana*) and Kayali (*G. atter*).

Percent reduction in cyanide content (ppm) of fresh shoots after boiling for 15 minutes from a bamboo plantation in Sta.Cruz (Laguna Province) and another in Davao was significant for all bamboo species (Caasi-Lit et al. 2010). The highest cyanide content in fresh samples was observed in *B. vulgaris* followed by *B. philippinensis* while the lowest was observed on *D. latiflorus*. Comparison of the cyanide content (pooled means from the two sites) among the three genera of common bamboos in the Philippines showed that *Bambusa* had the highest content followed by *Gigantochloa* and the least on *Dendrocalamus*.

Plantation Establishment for Bamboo Shoot Production

As of this date, no large bamboo plantations have been established for bamboo shoot production in the Philippines except for small scale production from existing plantations originally intended for banana propping pole production. The following observations and data on bamboo plantation establishment for shoot production were derived from two field studies conducted in Tagum, Davao and Sta. Cruz, Laguna (Caasi and Caasi-Lit 1999).

Common Practices and Cultural Management

Depending on the bamboo species that will be used, mulching is recommended several months after the clumps are ready for harvesting. Machiku (*D. latiflorus*), a fast growing species as reported by Pao-cahng Kuo (1978) was observed to produce shoots after two years under Philippine conditions especially in Davao Province. This area has a Philippine Type IV weather where it rains for almost ten months giving enough moisture for shoot development. In Laguna and Davao conditions, *Gigantochloa* species can be harvested after three years (Caasi-Lit et al., 1999).

The regular cultivation in between clumps and around the bamboo grove can initially improve the soil and eventually loosen the soil for better shoot production. Very old clumps that have not produced any shoots during the first year are removed. Cleared spaces allow underground shoots to emerge. Cutting the top shoot of the bamboo clump can induce shooting.

Important Notes Relevant to the Establishment of Bamboo Shoot Farm

Rhizomes versus Cuttings

Depending on the kind of planting propagules to be used, Table 2 compares the production of shoots using the rhizomes and cuttings as the mother plant. Using rhizomes, shoots can be harvested already even after only two years of establishment; using cuttings, shoots can be harvested only on the third year. Generally, planting matured rhizomes can generate more shoots after a year because they contain several growing points or shoots located at the base of the stump. The major disadvantage of using rhizomes is the difficulty in harvesting the stump and this demands higher price. If cuttings are considered for the operation during the first year, it is also feasible to do the propagation activities in the Bamboo Nursery during the first six months. This will lessen the cost of production in the establishment of the bamboo shoot plantation. However, the only disadvantage of using bamboo cuttings for planting is the longer time (at least three years) to produce quality shoots. Since this figure is based on natural rainfall (6 months rain and 6 months dry), the number of shoots produced will be different if drip irrigation will be available the whole year round.

Table 2. Estimated number of shoots (average) produced using rhizomes and culm/branch cuttings (Laguna/Davao conditions).

Type of planting materials	Year 1	Year 2	Year 3
Rhizomes	6	18	40
Cuttings	3	12	30

Shoot production

Based on previous observations by Caasi & Caasi-Lit (1999) and Caasi (2012) in the different bamboo plantations in Laguna and Davao, the estimated number of shoots produced by several species of bamboo is shown in Table 3. Virtucio et al. (1994) reported the actual shoots produced by the endemic species “Laak” at 35 shoots on the third year.

Table 3. Estimated number of shoots (average) produced by several bamboo species (Laguna/Davao conditions).

Bamboo species	Year 1	Year 2	Year 3	Year 4	Reference
Tinik	4	8-10	25		Caasi & Caasi-Lit, 1999; Caasi, 2012 PC
Laak	5-7	18-20	50		Caasi & Caasi-Lit 1999; Caasi, 2012 PC
Laak	5-7	18	35	44	Virtucio et al. 1991
Kayali	5-7	20-24	50		Caasi & Caasi-Lit 1999; Caasi, 2012 PC
Bolo	5-7	18	35		Caasi & Caasi-Lit 1999; Caasi, 2012 PC
Giant	5	8-10	25		Caasi & Caasi-Lit 1999; Caasi, 2012 PC
Machiku	5-7	20-24	50		Caasi & Caasi-Lit 1999; Caasi, 2012 PC

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Cost Benefit Analysis in Bamboo Shoot Farming

Table 4 shows the cost of propagating 10,000 pieces one-node bamboo culm/branch cuttings using the Caasi Method of bamboo propagation (Incubation Method). With this method, a single plant propagule or cutting will cost Php34.80. The cost of establishing a hectare of bamboo shoot farm using the different bamboo species is shown in Table 5. Based on previous research done in Laguna Province (Caasi & Caasi-Lit 1999), the return on investment for the production of bamboo shoots after three years using different bamboo species is shown on Table 6. The number of shoots produced after three years is also indicated as this gives an estimate of the total shoot production. More shoots in the succeeding years will come out as the bamboo plant matures especially when irrigation and plant maintenance are properly performed. Based on our estimate, it is therefore practical to engage the three species (Giant bamboo, Machiku and Kayali) into bamboo shoot production for greater profit.

Table 4. COST AND RETURN ANALYSIS for propagating one-node bamboo culm/branch cuttings using the Caasi method of bamboo propagation.

PROCESSES	AMOUNT IN PHILIPPINE PESO	DAY
A.Acquisition of Materials		
1. Cuttings – 10,000 pcs x P5/cutting	50,000	1
2. Transport	15,000	
3. Treatment (Fungicide) x 2 packs + labor	2,400	
Sub-total	67,400	
B.Incubation site		
1. Materials for shed (bamboo nursery,optional)	(35,000)	1-5
2. Labor for incubation site (4 mp x 5 da x 250/da)	5,000	
3. Drums (for soaking)	15,000	
Sub-total	55,000	
C. Incubation process		
1. Labor for planting (5 mp x 5 da x 250/da)	6,250	6-21
2. Treatment (4kgs fungicide x 800/kg)	3,200	
(4 bottles – Growth Enhancer x 400)	1,600	
3. Water bill (for 10 cu. m x 15 days x 40/cu. m)	6,000	
4. Insecticide (1bottle x 1200)	1,200	
5. Labor for watering for 15 days		
(1 mp x 15 da x 250)	3,750	
Sub-total	22,000	
D.Bagging/transplanting		
1. Soil mix = 1 part soil: 1 part coir dust		
(1liter/bag) (1cu. m : 100 bags)		22-30
(10,000 planting = 10 cu.m x 500)	5,000	
(coir dust = 10 cu.m x 400)	4,000	
2. Labor for soil mix and planting		
(10,000 pcs x 4/bag)	40,000	
3. Plastic bags 6x8 (10,000 x 3/bag)	30,000	
4. Punching plastic bag (3 md x 250)	750	
5. Puncher (3 units x 500/unit)	1,500	
Sub-total	81,250	

E. Maintenance 1. Insecticide/Fungicide (every 7 days, 6 x) 2 bots Plant Enhancer x 400) = 800 x 6 = 4,800 1 bot Insecticide x 1,200 = 1,200 x 6 = 7,200 1 kg Fungicide x 800 = 800 x 6 = 4,800 2. Labor for everyday watering 21-60 = 40 days x 2 md x 250 4. Water requirement 1 cu.m/da x 40 da = 40 cu.m x 100	4,800 7,200 16,800 20,000 4,000	31-70
Sub-total	52,800	
TOTAL EXPENSES	278,450	
Less 20% Mortality from different causes		
COST PER SEEDLING (MATERIALS & LABOR)	34.80	
THROUGHPUT TIME	60-70 DAYS	

Table 5. Cost of establishing <u>one-hectare</u> bamboo shoot farm using the different bamboo species (In Peso).

INPUT COSTS						
	Tinik	Laak	Kayali	Bolo	Giant	Machiku
Population per Hectare (4x4)	625	625	625	625	625	625
A. Site Preparation Line brushing/weeding/ staking/sticking/lay-outing (Labor: 5mp x 8da x 250/da	10,000	10,000	10,000	10,000	10,000	10,000
B. Digging, basal fertilizer application, planting, mulching, watering	12,000	12,000	12,000	12,000	12,000	12,000
C. Cost of Fertilizer (complete)	1,200	1,200	1,200	1,200	1,200	1,200
D. Cost of Planting Materials 1. (Rhizomes) Tinik, Machiku, Laak@60; Giant, Kayali, Bolo @80	37,500	37,500	50,000	50,000	50,000	37,500
D2. Cuttings @34.80	21,750	21,750	21,750	21,750	21,750	21,750
E. Cost of Hauling to planting site Truck+Barge (approximate only)	20,000	20,000	20,000	20,000	20,000	20,000
F. Maintenance Labor (after 2nd, 6th and 12th month)[1]	40,500	40,500	40,500	40,500	40,500	40,500
(After planting – ring weeding, cultivating, fertilizing, return mulch, and other operations)	12,000	12,000	12,000	12,000	12,000	12,000
Replanting of dead plants (=5% mortality)[2]	2,812.50	2,812.50	3,437.50	3,437.50	3,437.50	2,812.50
Clearing/Rejuvenating of clumps after 12 months[3]	4,500	4,500	4,500	4,500	4,500	4,500
G. Supervision, technical fee and other miscellaneous expenses	78,000	78,000	78,000	78,000	78,000	78,000

Total Cost Per Hectare Using Rhizomes	218,512.50	218,512.50	231,637.50	231,637.50	231,637.50	218,512.50
Total Cost Per Hectare Using Cuttings	202,762.50	202,762.50	207,887.50	207,887.50	207,887.50	202,762.50

[1] Labor cost is computed at the rate of PHP250/day
[2] Computation to get cost and replanting: 5% of 625 = 31.25 x 60 & 80 (cost of rhizome) + Labor [(PHP30@ x 31.25) = PHP 937.50]; For Rhizome=[2,812.50 @ 60 and 3,437.50 @80]; For Cuttings= 34.80 per cuttings.
[3] Clearing/Rejuvenating means the removal of small and old dry culms to allow faster development of more shoot.

Table 6. Return on investment for production of bamboo shoots in one hectare after three years for several species of Philippine bamboos (Laguna/Davao conditions).

ITEMS	TINIK	LAAK	KAYALI	BOLO	GIANT	MCKU
Population density per hectare (4x4)	625	625	625	625	625	625
Estimated number of shoots per clump after 3 years*	25	50	50	40	40	50
Total shoots produced	15,625	31,250	31,250	25,000	25,000	31,250
Mortality rate	20%	20%	20%	20%	20%	20%
Number of mortality	3,125	6,250	6,250	5,000	5,000	6,250
Number of survival	12,500	25,000	25,000	20,000	20,000	25,000
Approximate Weight of peeled shoots (Average of Laguna and Davao conditions)	0.8	0.45	0.8	0.8	1.5	0.8
Total kilos	10,000	11,250	20,000	16,000	30,000	20,000
Estimated Market Price per kilo of bamboo shoots (only the least estimate, possible to be different among species)	50	50	50	50	50	50
GROSS INCOME	555,000	562,500	1M	800,000	1.5M	1M
Less Estimated Cost of investment (using figures from Table 5)	218,512.50	218,512.50	231,637.50	231,637.50	231,637.50	218,512.50
Less Estimated Cost of harvest, transport & other miscellaneous expenses	180,000	180,000	180,000	180,000	180,000	180,000

GROSS INCOME 3rd Year (Estimate without capital outlay, and all other expenses)	156,487.50	163,987.50	588,362.50	388,362.50	1.08M	601,487.50
GROSS INCOME 4th year onwards (does not include the first year cost of investment, capital outlay, etc.	375,000	382,000	820,000	620,000	1.32M	820,000

Challenges in Bamboo Shoot R& D

Bamboo shoot production is a very promising venture. However, it is beset with problems and difficulties especially the insufficient bamboo shoot R & D that will serve as the backbone for appropriate, locally adapted farming and production technologies.

1. Lack of basic knowledge and information on bamboo shoots, including identification, shelf life cyanide content, nutritional properties, etc.
2. Difficulty in propagating the species which produce quality shoots such as *Dendrocalamus* spp, and *Gigantochloa* spp.
3. Rampant pilferage of young shoots during the conduct of studies and research implementation.
4. Lack of information on other local bamboo species with potential shoot quality because shoot production techniques are very specific and species-specific
5. Dearth of information on the R&D on bamboo shoot production
6. Limited knowledge and information on site preparation, cultural management practices, suitable bamboo species for food, propagation techniques; harvesting and product development, socio-economics of utilization and marketing
7. Insect pests and diseases of bamboo shoots should be continuously studied especially yield loss assessment
8. Lesser appreciation on the potential of bamboo shoots as a viable small scale industry for rural farmers or even larger business ventures
9. Only few researchers are working on R&D of bamboo shoot production which need careful study and a lot of expertise, practice and experience
10. Lack of funding for basic research on bamboo shoots and low priority by funding agency

Current Prospects in Bamboo Shoot Initiatives

In the Philippines, there is now a growing movement towards innovative, healthy, nutritious and affordable food enriched with bamboo shoots such as native delicacies, viands, breads, pastries, desserts, pasta, snacks and beverages. Like-minded individuals, environmental advocates, academe, cooperatives, private organizations, NGOs and public institutions actively take part in sustainable livelihood and inclusive growth for poor & marginalized communities through bamboo agri-ecotourism and training of communities in social entrepreneurship, propagation, plantation management, food safety and quality, good manufacturing processes, fair trade, processing, production, packaging, marketing and development of food products made from bamboo combined with indigenous materials. These

endeavors are featured online and via multimedia (TV/radio/print), cooking demos, local & international expos/trade fairs/conferences, arts and cultural events, educational scholarships, feeding programs, medical missions, healthcare, peacebuilding initiatives, disaster relief/ reduction/risk management and rehabilitation programs. Some financial institutions have opened credit facilities for community based-micro and small bamboo enterprises. A draft Philippine Bamboo Industry Roadmap has been submitted and stakeholders' roundtable discussions/consultations are ongoing. There is also a huge potential for global Halal certified bamboo shoot food & beverages.

Summary and Recommendations

This paper presents the status and prospects of bamboo shoots as potential food source or as vegetable in the Philippines. Bamboo shoots are undoubtedly one of the nutritious food source available in the country. There are several local bamboo species with quality vegetable shoots in different regions with *B. blumeana* as the predominant species and preferred by most consumers. Bamboo shoot farming is a potential business venture especially in the rural areas and this can be a source of livelihood for the rural folks. Some unpublished data and observations based from previous studies in Davao and Laguna on shoot characteristics and plantation establishment of some local bamboo species are also presented. Aspects on the economic benefits of bamboo shoot farming using the locally available bamboo species are shown. Among the bamboo species, Giant bamboo and Machiku are the most profitable for bamboo shoot farming. Problems in bamboo shoot R&D and constraints in production and utilization are also enumerated with lack of funding for basic studies on bamboo shoots cited as the major constraint. The paper also encouraged the continuous use of bamboo shoots as food source in the Philippines and discussed the current prospects in bamboo shoots initiatives as demonstrated in recent activities among public, private and academic agencies.

To date, research and development on bamboo shoots as food as well as production of bamboo shoots for food are very limited. In this light, there is a need to study and strengthen bamboo shoots R &D. The potential of bamboo shoots as food source is an area that needs a lot of scientific experimentation and financial support. It is hoped that the government and private companies will consider bamboo shoot R&D, extension and technology as important vehicle for food security, poverty alleviation, environmental protection and climate change mitigation. Priorities in the following aspects are recommended:

1. Continue survey of more species with bamboo shoot potential and evaluation of their cyanide content and nutritive properties
2. Research and development on off-season bamboo shoot production to cater the supply of bamboo shoots during the dry season
3. More funding and investments for bamboo shoot R&D and capacity building of community based- bamboo agri-social enterprises in various aspects of the value chain
4. Include bamboo shoot as vegetable crop in agricultural system and disseminate its importance as food and as a climate change crop.
5. Approval of the upgraded Philippine Bamboo Industry Roadmap.

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Figure Captions

Figure 1. Shoot characteristics (a) and clump (b) of *Bambusa blumeana* (Kawayang tinik) and shoot characteristics (c) and clump (d) of the endemic species, *Bambusa merrilliana* (Bayog).

Figure 2. Shoot characteristics (a) and clump (b) of the endemic species, *Bambusa philippinensis* (Laak) and shoot characteristics (c) and clump (d) of *Gigantochloa atter* (Kayali).

Figure 3. Shoot characteristics (a) and clump (b) of *Gigantochloa levis* (Bolo) and shoot characteristics (a) of *Dendrocalamus asper* (Giant bamboo).

Figure 4. Shoot characteristics (a) and clump (b) of *Dendrocalamus latiflorus* (Machiku).

Figure 5. Comparison of the external features of fresh whole young shoots (a) and peeled fresh shoots (b) of the different local bamboo species.

Figure 6. Longitudinal sections of pagoda-shaped young shoots of *Gigantochloa* spp. (a. Kayali, b.Bolo) and *Bambusa* spp. (c. Laak, d,Kiling) showing the tapering hollow portion (internode) and the filled layers (nodes).

Figure 7. Longitudinal sections of pagoda-shaped young shoots of *Dendrocalamus* spp. (Giant bamboo, Machiku) showing the solid and with very small hollow central portion of the shoots.